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2015-03

Compilation of abstracts, March 2015

Monterey, California; Naval Postgraduate School

http://hdl.handle.net/10945/45535
COMPILATION OF ABSTRACTS

Unrestricted Theses, Dissertations, and Final Projects

NPS Class of March 2015
This publication, *Compilation of Abstracts*, contains abstracts of unrestricted theses, capstone project reports, and dissertations submitted for the master of arts, master of business administration, master of science, and doctor of philosophy degrees for the Naval Postgraduate School’s March 2015 graduating class.

This compilation is published to acquaint those interested in the fields represented with the nature and substance of Naval Postgraduate School student research, which covers a wide range of defense-related topics. An online copy of this and previous editions can be found at [http://www.nps.edu/Research/MoreThesisAbst.html](http://www.nps.edu/Research/MoreThesisAbst.html). Calhoun, the institutional archive of NPS, provides a convenient way to search the content of unrestricted theses. Access Calhoun at [http://calhoun.nps.edu/public/handle/10945/6](http://calhoun.nps.edu/public/handle/10945/6). Restricted theses are available for viewing on the NPS SIPRNet and through the Defense Technical Information Center at [http://www.dtic.mil/dtic/customer/](http://www.dtic.mil/dtic/customer/).

Guidelines for obtaining printed copies of *Compilation of Abstracts* are outlined on the last page of this volume.

**Additional Information on NPS Research and Academic Programs**

*Summary of Research*, an annual compilation of research projects and publications, is also available online at [http://www.nps.edu/Research/SummaryRes.html](http://www.nps.edu/Research/SummaryRes.html). “Research News,” a monthly newsletter highlighting some of the newest developments in NPS research, can be found at [http://www.nps.edu/Research/Newsletters.html](http://www.nps.edu/Research/Newsletters.html).

For other inquiries about student and faculty research at NPS, please contact the Dean of Research, Jeffrey Paduan:

Naval Postgraduate School  
Monterey, CA 93943-5138  
Phone: (831) 656-3008  
Fax: (831) 656-2038  
Email: research@nps.edu

For details on degree programs at NPS, please contact the director of admissions at (831) 656-3093 or grad-ed@nps.edu. The NPS academic catalog is available at [http://www.nps.edu/Academics/GeneralCatalog/Layout.html](http://www.nps.edu/Academics/GeneralCatalog/Layout.html). The admissions website is at [http://www.nps.edu/Academics/Admissions/Index.html](http://www.nps.edu/Academics/Admissions/Index.html).
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INTRODUCTION

The Naval Postgraduate School is pleased to present the thesis, capstone-project report, and dissertation abstracts (hereafter thesis or terminal project) for unclassified research completed in March 2015 by the graduating class.

MISSION

The Naval Postgraduate School (NPS) was established to serve the advanced educational needs of the Navy. The broad responsibility of NPS is reflected in its stated mission:

“To increase the combat effectiveness of commissioned officers of the naval service to enhance the security of the United States. In support of the foregoing, and to sustain academic excellence, fosters and encourages a program of relevant and meritorious research which both supports the needs of the Navy and Department of Defense (DOD) while building the intellectual capital of the Naval Postgraduate School faculty.

To fulfill its mission, the Naval Postgraduate School strives to advance innovation in the Navy and prepare officers for introducing and employing future technologies. The research program at NPS supports the mission of graduate education. Research at NPS

• challenges students with creative problem solving experiences on DOD-relevant issues;
• solves warfare problems; and
• attracts and retains quality faculty with state-of-the-art expertise.

To meet its educational requirements, the Navy has developed a unique academic institution at NPS and via distance learning (DL) through specially tailored academic programs and a distinctive educational experience tying academic disciplines to naval and joint warfighting applications. NPS has aligned its education and research programs to achieve three major goals:

1. nationally recognized academic programs that support the operations of the Navy and Marine Corps, our sister services, and our allies;
2. research programs that focus on the integration of education and research in support of current and emerging national security technologies and operations; and
3. executive and continuing education programs that support sustained intellectual innovation and growth throughout an officer’s career.

ACADEMIC PROGRAMS

School of International Graduate Studies (SIGS)

The unique programs and faculty expertise within SIGS seek to identify and address current and emerging security challenges and strengthen multilateral and bilateral defense cooperation between the United States and other nations. Areas of expertise range from nuclear nonproliferation to counterterrorism; from the history of war to emerging biological and cyber threats; and from the security aspects of political economy to international law.

• Civil–Military Relations
• Combating Terrorism Strategy and Policy
• Defense Decision Making and Planning
• Homeland Security and Defense
• Security Studies
• Stabilization and Reconstruction
• National Security and Intelligence, Regional Studies:
  - Middle East, South Asia, Sub-Saharan Africa
  - Far East, Southeast Asia, the Pacific
  - Europe and Eurasia
  - Western Hemisphere
Graduate School of Business and Public Policy (GSBPP)

GSBPP reflects the management side of national defense in support of operational requirements, with programs open to the U.S. uniformed services, DOD employees and contractors, federal employees, and international military and government employees. An integrated civilian and military faculty focuses on defense organizations, system applications, and instruction supported by extensive defense-oriented research.

- Acquisition and Contract Management
- Advanced Acquisition Program
- Contract Management (DL)
- Defense Business Management
- Defense Systems Analysis
- Defense Systems Management
- Executive MBA (DL)
- Financial Management
- Information Systems Management
- Material Logistics Support
- Manpower Systems Analysis
- Program Management (DL)
- Supply-Chain Management
- Systems Acquisition Management
- Transportation Management

Graduate School of Engineering and Applied Sciences (GSEAS)

GSEAS provides advanced education in engineering and applied sciences while developing technological advances with strict application to DOD needs, thus setting it apart from civilian graduate schools of engineering. It is focused on preparing the next generation of U.S. and international leaders, military and civilian alike, for the uncertainties and challenges of a rapidly changing technological world.

- Applied Mathematics
- Combat Systems Sciences and Technology
- Electronic Systems Engineering (residential and DL)
- Mechanical Engineering for Nuclear-trained Officers (DL)
- Meteorology and Oceanography
- Meteorology
- Naval/Mechanical Engineering
- Oceanography
- Operational Oceanography
- Reactors–Mechanical/Electrical Engineering (DL)
- Space Systems Engineering
- Space Systems Operations (residential and DL)
- Systems Engineering (residential and DL)
- Systems Engineering Management (DL)
- Undersea Warfare
- Underwater Acoustic Systems (DL)

Graduate School of Operational and Information Sciences (GSOIS)

GSOIS delivers graduate-level education and conducts cutting-edge research in four non-traditional knowledge domains responsive to U.S. military needs: information science and technology, military computer science, military operations analysis and research, and special operations and related defense analysis.

- Applied Cyber Operations
- Computer Science (residential and DL)
- Computing Technology (DL)
- Cyber Systems and Operations
- Cost Estimating and Analysis (DL)
- Electronic Warfare Systems (International)
- Human Systems Integration
- Identity Management and Cyber Security (residential and DL)
- Information Sciences
- Information Systems and Operations
- Information Systems and Technology
- Information Warfare
- Joint C4I Systems
- Joint Information Operations
- Joint Operational Logistics
- Modeling, Virtual Environments, and Simulation
- Operations Analysis
- Remote Sensing
- Software Engineering (residential and DL)
- Special Operations
- Systems Analysis (DL)

Office of the Provost

The Office of the Provost provides oversight to a specialized degree program that leads to a master of science in systems engineering analysis. Students benefit from cross-disciplinary course offerings and research opportunities found in GSEAS systems engineering and GSOIS systems and operational analysis curricula.

- Systems Engineering Analysis
STUDENT POPULATION

The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government, and international military officers and government civilians. The student population distribution for March 2015 is shown in Figure 1.

Figure 1: Total enrollment by student type for winter 2015 (2,751 total). Source: NPS Academic Affairs Quarterly Enrollment Report, Winter 2015.

STUDENT RESEARCH

Independent scholarly work in the form of a dissertation (PhD), thesis (Master’s/Engineer), or capstone project is required for most academic programs. Student research projects address issues ranging from the current needs of the fleet and joint forces to the science and technology required to sustain long-term superiority of the Navy and DOD. Guided by faculty advisors, NPS students represent a vital resource within the DOD for addressing war-fighting problems and maintaining cutting-edge expertise, particularly in a time when technology and information operations are changing rapidly. Naval Postgraduate School alumni think innovatively and possess the knowledge and skills to apply nascent technologies in the commercial and military sectors. Their firsthand grasp of operations, when combined with challenging projects that require them to apply their focused graduate coursework, is one of the most effective elements in solving fleet, joint-force, and regional problems. NPS graduate education encourages a lifelong capacity for applying basic principles and creative solutions to complex problems. NPS is also unique in its ability to conduct classified research. Classified theses are available on the NPS SIPRNet.
DEGREES OFFERED

Curricula meet defense requirements within the traditional degree framework through residential or distance-learning status. All curricula lead to a master of science or art or a master of business administration; additional study may yield an engineer or doctoral degree. Below is a listing of degrees offered at the Naval Postgraduate School.

**Doctor of Philosophy**
- Applied Mathematics
- Applied Physics
- Astronautical Engineering
- Computer Science
- Electrical Engineering
- Engineering Acoustics
- Information Sciences
- Mechanical Engineering
- Meteorology
- Modeling, Virtual Environments, and Simulation
- Operations Research
- Physical Oceanography
- Physics
- Security Studies
- Software Engineering
- Systems Engineering
- Systems Engineering Analysis

**Master of Science**
- Applied Cyber Operations
- Applied Mathematics
- Applied Physics
- Applied Science
- Astronautical Engineering
- Combat Systems Technology
- Computer Engineering
- Computer Science
- Computing Technology
- Contract Management
- Cyber Systems and Operations
- Defense Analysis
- Electrical Engineering
- Electronic Warfare
- Systems Engineering
- Engineering Acoustics
- Engineering Science
- Engineering Systems
- Human Systems Integration
- Information Operations
- Information Systems and Operations
- Information Technology Management
- Information Warfare Systems Engineering
- Management
- Mechanical Engineering
- Meteorology
- Meteorology and Physical Oceanography
- Modeling, Virtual Environments, and Simulation
- Operations Research
- Physical Oceanography
- Physics
- Product Development
- Program Management
- Remote-Sensing Intelligence
- Software Engineering
- Space Systems Operations
- Systems Analysis
- Systems Engineering
- Systems Engineering Analysis
- Systems Engineering Management
- Systems Technology

**Master of Arts**
- Identity Management and Cyber Security
- Security Studies

**Master of Business Administration**

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MARCH 2015 DEGREES CONFERRED

The March 2015 graduating class produced 126 unrestricted theses, dissertations, capstones, and final project reports as part of the graduation requirement. Figure 2 indicates the distribution of degrees awarded by academic program.

Figure 2. Distribution of degrees conferred by academic program, March 2015 (unrestricted theses)
ACADEMIC AWARDS ANNOUNCED MARCH 2015

The following listing provides recognition to those students selected by NPS faculty or military associations for superior academic achievement. Quite a few departments honor graduating students for the quality and contributions made by their theses, dissertations, or capstone reports.

Campus-wide Awards

- Monterey Council Navy League Award for Highest Academic Achievement: LT Timothy S. Shaffer, USN
- Marine Corps Association Superior Service Award for Outstanding U.S. Marine Student: Capt Anthony Pollman, USMC
- Association of the United States Army, General Joseph W. Stilwell Chapter, Award for Outstanding Army Student: MAJ Michael S. Senft, USA
- Air Force Association Award for Outstanding U.S. Air Force Student: Capt Katherine Lockhart, USAF
- Naval Postgraduate School Outstanding Academic Achievement Award for International Students: Lt Col Arthur Alexandre Gentil Toneli, Brazilian Air Force
- Naval Postgraduate School Superior Service Award: Maj Creighton A. Mullins, USAF
- The Outstanding United States Air Force Graduate Award, Department of National Security Affairs: Capt Duilia Mora Turner, USAF

Graduate School of Business and Public Policy (GSBPP)

- The Louis D. Liskin Award for Excellence in Business and Public Policy: Capt Matthew Curry, USMC, LT Andrew Poreda, USN, and LCDR Aaron Massey, USN
- The Graduate School of Business and Public Policy Faculty Outstanding International Student Award: LT Col Arthur Alexandre Gentil Toneli, Brazil and CPT Ugur Ugurbas, Turkey
- RADM Donald R. Eaton Logistics Award for Outstanding Achievement: Capt Charles Mohler, USMC and Capt Emmaline Hill, USMC
- Chief of Naval Personnel Award for Academic Excellence in Manpower, Personnel, and Training Analysis: LCDR Brett Williams, USN and Capt Matthew Curry, USMC

Graduate School of Engineering and Applied Sciences (GSEAS)

- Space and Naval Warfare Systems Command Award in Electronic Systems Engineering: MES Lee Woei Chieh, Singapore Navy
- Naval Sea Systems Command Award in Naval/Mechanical Engineering: LT Eid Fakhouri, USN
- The Surface Navy Association's Award for Excellence in Surface Warfare Research: LT Steven Rockwell, USN and LT Dustin Schultz, USN
- Chief of Naval Operations Undersea Warfare Award: LT Tim Erickson, USN

Graduate School of Operational and Information Sciences (GSOIS)

- Military Operations Research Society Stephen A. Tisdale Graduate Research Award: LT Timothy S. Shaffer, USN
- Chief of Naval Operations Award for Excellence in Operations Research: LT Timothy S. Shaffer, USN
- Fleet Cyber Command Award for Academic Achievement in Cyber Operations: LT Andrew J. Adams
- John McReynolds Wozencraft Electrical and Computer Engineering Academic Honor Award: Mr. Anthony Kubat Jr., Edwards Air Force Base
- Rear Admiral Grace Murray Hopper Computer Science Award: Mr. Austin L. West
- Network Operations and Technology Outstanding Graduate Award: LT Bruce William Hill, USN

School of International Graduate Studies (SIGS)

- The Louis D. Liskin Award for Excellence in Regional Security Studies: Maj Creighton A. Mullins, USAF
• The International Student Award for Excellence in Regional or Security Studies: CAPT Jerry Kwok Song Lee, Republic of Singapore Navy
• The Hans Jones Award for Excellence in Thesis Research in Special Operations and Irregular Warfare or Security, Stabilization, Transition and Reconstruction: Maj Sergei A. Medvedev, USAF
• The Philip Zimbardo Award: Detective Robert Runnels; Los Angeles Police Department, California

Institutes and Centers Awards
• Naval Intelligence Foundation, Admiral Bobby Ray Inman Award for Outstanding Performance in the Field of Intelligence: LCDR Henry Lange, USN
MASTER OF ARTS

Security Studies
Nepal’s age-old ethnic grievances created a platform for the Maoists to launch their political strategy into broad sections of Nepalese society. The explicit politicization of ethnic grievances helped propel the party to victory in Nepal’s first constitutional election in 2008. Soon thereafter, however, the Maoists lost the lead role in Nepalese politics, in no small part because they failed to deliver on their ethnic promises. This thesis examines the rise and fall of the Maoists in Nepal, as well as the sources and context of the ethnic grievances that have simmered in the country throughout its modern political history. It finds that genuine reform has collided with (and frequently lost out to) the short-term agitations of power politics across the partisan spectrum. In this context, the present thesis establishes a framework to understand the role of ideas in democratizing states. The clash between ideas and ideology on the matter of ethnic grievances sheds light on how the Maoists failed to convert the claims of their movement into the actions of their party in government. The lesson for the remaining parties is clear: resolving Nepal’s ethnic tensions is a matter of ongoing urgency in the country’s democratization.

Keywords: Nepal, democratization, democratic consolidation, Shah rule, Rana rule, Monarchs, The Nepali Congress, Maoism, insurgency, Maoist Insurgency, People’s War, ethnicity, ethnic minorities, ethnic grievances, ethnic politics, caste

The South China Sea is one of the maritime hot spots in the world and perhaps accounts for more clashes than other disputed waters, due to the abundancy of the natural resources that can fulfill the region’s rising demand of energy and food. Six countries currently claim some or the whole part of the South China Sea: Brunei, China, Malaysia, the Philippines, Taiwan, and Vietnam, all with overlapping claims. Although the South China Sea claimant countries have clashes with each other, the close proximity of the Philippines and Vietnam to China has contributed the greatest number of clashes. The modernization of naval forces in the region, combined with the increasing frequency and seriousness of these clashes, suggests that they may escalate to the level of military conflict. However, in almost every case, the vessels involved are civilian, not military. Without coordination and control between those agencies and naval forces from each country, there is a risk that those incidents could still escalate into military conflict. This condition highlights the importance of civil-military
relations; in particular, effective coordination between civil and military agencies within each country, and between the civilian and military agencies of each party in the dispute.

Keywords: civil–military relations, civilian and military maritime cooperation, the South China Sea disputes, maritime conflict prevention, the Philippine Navy and the Philippine Coast Guard, the Vietnam People's Navy and the Vietnam Coast Guard

THE EVOLUTION OF MALAYSIA'S IMMIGRATION POLICY SINCE 1970
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Advisor: Michael Malley, Department of National Security Affairs
Second Reader: Tristan Mabry, Department of National Security Affairs

In the 1970s, Malaysia's government promoted economic growth through an economic structural change from agriculture to industry. During the economic changeover, Malaysia's lack of human capital contributed to the persistent labor shortages. To meet the demand for labor, especially in manufacturing and construction, the government adopted a liberal immigration policy that permitted large numbers of workers to enter the country. Although many entered legally, many more did not. Most workers entered from Indonesia, which was close in proximity and shared a common culture. By the 1990s, many Malaysians increasingly began to blame immigrants for societal woes and economic setbacks. The government found itself in a quandary. Its immigration policy was promoting economic growth, but also generating opposition from society. Public opinion about both effects of immigration policy—economic growth and public opposition—could determine political outcomes. In response to public pressure, the government adopted a more restrictive immigration policy. During the 2000s, the Malaysian government deported tens of thousands of illegal immigrants annually. The government's crackdown on illegal immigrants specifically targeted Indonesians. The government's economic policies, however, still favored sectors that depended heavily on immigrant workers. This thesis analyzes two periods of time—1970–1990 and 1990–2010—to determine whether labor demand, government approval, or public pressure influenced the drastic change in Malaysia's immigration policy.

Keywords: Malaysia, immigration, Indonesia, illegal immigration, migration

LIBYA: A CONTEMPORARY CONFLICT IN A FAILING STATE
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The Arab Spring spread throughout the Middle East and North Africa, and what started in hope quickly devolved into struggles for formal and informal power. Violence in Libya was intensified by institutions’ inabilities to maintain governance, contain violence, and quell the rise of armed groups. Power in Libya is in constant contention by opportunistic tribal and regional militias, Islamist groups, and government and military power brokers. Libya is on the verge of becoming a failed state; allowing Libya to fail will have local, regional, and international repercussions. The challenge is to understand why the loosely formed alliances between government and tribal, regional, and Islamist militias are falling apart. The introduction of the Islamic State in Libya increases the urgency for these disparate groups to resolve their differences. This thesis concludes that Gadafi nurtured a sentiment of distrust between the people, Islamists, and government institutions. This trust deficit in post-revolutionary Libya has stymied cooperation and progress. Any meaningful solutions will have
to address the core issue of social trust, the emergence of the Islamic State, and economic weakness before reconciliation or reforms can occur.

Keywords: Libya, militias, armed groups, Arab Spring, state failure, Islamism, Ansar al-Sharia, insurgency, Islamic State, ISIS

MAKING THE CASE FOR HUMANITARIAN INTERVENTION: NATIONAL INTEREST AND MORAL IMPERATIVE
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Second Reader: James Russell, Department of National Security Affairs

Complex considerations challenge U.S. political leaders when faced with the possibility of humanitarian intervention by means of military force. Humanitarian intervention is a delicate matter in which decision makers are constrained or compelled by circumstances of national interest and moral imperative. This examination of humanitarian intervention reviews the foreign policy context and debate within the U.S. government across three case studies: Rwanda, Kosovo, and Libya. Each case study reveals the role of national interest and moral imperative in driving policymakers to a tipping point at which they make the final determination to use or refrain from military force. Both national interest and the desire to end human suffering serve as incentives for intervention, and one may be stronger than the other in any given situation.

Keywords: humanitarian intervention, Rwanda, Kosovo, Libya

THE STRATEGIC AND POLITICAL IMPACTS OF COLLATERAL DAMAGE FROM STRIKE WARFARE
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Second Reader: David Anderson, Department of National Security Affairs

It is hard to argue that there is a more prevailing issue than collateral damage when discussing strike warfare today. The outlook of the United States and other militaries regarding bombing operations, particularly concern about collateral damage, is a historically contingent process. This thesis reviews three case studies—the Korean War, the Vietnam War, and the Kosovo air campaign—to examine the impact of concern about collateral damage on U.S. policy and strategy. It analyzes the disparity between collateral damage effects at the strategic, operational, and tactical levels over the span of a half century. A significant amount of research on the effects of collateral damage from strike warfare focuses on legal, humanitarian, and moral issues. To oversimplify, killing non-combatants is bad, but it happens, and not always by accident. Therefore, it is instructive to gain knowledge on how it affects policy and strategy. Depending on the conflict and time period, U.S. administrations and war strategists have put the priority of mitigating collateral damage at different levels. Understanding the reasoning and timing behind the political and military attitudes toward collateral damage is helpful to understanding how the potential for civilian casualties fits into military strategy as a whole.

Keywords: collateral damage, civilian casualties, strategic bombardment, air power, Korea, Vietnam, Kosovo
Homeland security leaders faced with managing a crisis event, such as a terrorist attack, will invariably be exposed to tremendous decision-making pressure. Typically, these leaders are working within the confines of hierarchically configured response organizations. Crisis response is complex, requiring flexibility and the collaboration of multiple homeland security response partners to be effective. Mission command and the tools used to communicate a leader's intent provide an alternative approach to hierarchical leadership norms. Decentralization of mission authority and promotion of self-initiative can increase the tempo of decision making and execution. The intent of this thesis is to examine the applicability of mission command for use in managing homeland security crisis response. Several perspectives are considered. First, the origins of mission command and the efforts by a military organization to implement this ethos are reviewed. Second, parallels between both the military and the homeland security response environments are examined. Finally, implementation challenges, implementation examples using the wildland fire experience, and opportunities for implementation within the homeland security enterprise are considered.

Keywords: mission command, auftragstaktik, homeland security crisis response, leadership, network, hierarchy, trust, leader's intent, decision making, sense making, just culture, situational awareness, high-risk work environments, mission orders, detailed orders

This thesis investigates the major influences on U.S. decision-making regarding the enlargement of the North Atlantic Treaty Organization (NATO) following the end of the Cold War. After the collapse of the Soviet Union, many questioned the need for the Alliance's continued existence. It was not obvious that NATO would survive, and indeed thrive in the twenty-first century. The United States has been the driving force behind NATO's surprising endurance and growth. This thesis identifies key factors that have motivated American decision-makers to support the expansion of the Alliance's membership since the end of the Cold War in 1989–1991. Time and again, evolving threats to transatlantic security have revealed the need to sustain the Alliance. Cold War fears of communist aggression were replaced by the dangers of instability created by ethnic and religious conflicts, as demonstrated in the Balkans. These dangers in turn gave way to menacing transnational terrorist organizations, including al Qaeda. As the threats changed, the importance of close political association at times trumped that of enhanced military capability. Cultivating the international community of free democracies by expanding NATO membership provided a framework to counter the emerging threats.

Keywords: North Atlantic Treaty Organization (NATO), NATO enlargement, NATO-Russia relations, U.S.-NATO relations, NATO post-Cold War
STRATEGIC IMPROVEMENTS TO TSA SPOT PROGRAM
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Advisor: Lauren Wollman, Center for Homeland Defense and Security
Co-Advisor: John Rollins, Center for Homeland Defense and Security

This study of Transportation Security Administration’s Screening Passengers by Observation Techniques (SPOT) program analyzes the Government Accountability Office (GAO) and Office of Inspector General (OIG) recommendations for improvement, as well as strengths and weaknesses of the program not specifically addressed in previous assessments. Any analysis of SPOT must be robust, as it represents one of the few threat agnostic countermeasures not limited by technology and finite detection capabilities. The GAO has recommended Congress withhold funding from SPOT until further evidence of effectiveness can be produced. The first portion of this study revisits the analysis of GAO and OIG in their respective reports. The GAO audits rely on meta-analyses that suggest human lie detection is no more successful than flipping a coin. This study assesses those claims, and reveals some contextual and analytical limitations of the claims. The OIG report offers similar claims, but adds additional insight into critical strategic areas. The second portion of this study focuses on the strengths and weaknesses of the SPOT program, including an analysis of several GAO and OIG conclusions. Many of the recommendations were operational in nature, and provided little strategic direction to improve the relevance, effectiveness, and credibility of the program. Analyzing strengths and weaknesses provides insight into more strategic recommendations that may improve the security value of SPOT.

Keywords: aviation security, behavior detection, Transportation Security Administration, human lie detection, behavioral psychology, SPOT, deception detection, risk-based security

CROWDSOURCING INTELLIGENCE TO COMBAT TERRORISM: HARNESSING BOTTOM-UP COLLECTION TO PREVENT LONE-WOLF TERROR ATTACKS
This paper has been recognized as an outstanding thesis by its department.
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Master of Arts in Security Studies (Homeland Security and Defense), 2015
Advisor: Erik Dahl, Department of National Security Affairs
Second Reader: Naazneen Barma, Department of National Security Affairs

U.S. officials have acknowledged that attackers of the lone-wolf and isolated-cell organizational type are on the rise and now pose a greater threat than major coordinated actions. Traditional intelligence methods, using a top-down approach with an emphasis on signals intelligence, are ill-equipped to identify and prevent terrorists using lone-wolf tactics. Crowdsourcing, as a problem-solving technique, is a relatively new idea but has shown great promise in tackling issues similar to the identification of lone-wolf terrorists. At its core, crowdsourcing is a method for thousands or even millions of people to contribute their knowledge, expertise, or skills towards a unified task. Done correctly, it has produced results unachievable by traditional tasking of humans or computers. This thesis identifies how the signals surrounding lone-wolf attacks are different and more subtle in nature from those mounted by organized terror groups. In turn, the thesis examines the potential benefits of crowdsourcing intelligence in order to strengthen the U.S. intelligence community’s ability to approach this emerging problem of lone-wolf terrorism. In short, this thesis proposes that the U.S. intelligence community harness the power of U.S. citizens to help prevent identify the subtle indicators presented by lone-wolf terrorists in order to prevent lone-wolf terrorist attacks.

Keywords: lone-wolf, terrorism, crowdsource, crowdsourcing, domestic intelligence, big data, distributed network, citizen participation
CAN THE 2014 COMPREHENSIVE AGREEMENT ON THE BANGSAMORO (CAB) SUCCEED IN MINDANAO WHERE PREVIOUS AGREEMENTS FAILED?
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Advisor: Michael Malley, Department of National Security Affairs
Co-Advisor: Tristan Mabry, Department of National Security Affairs

This thesis examines the major peace agreements between the Government of the Philippines (GOP) and the Moros. The study addresses whether the Comprehensive Agreement on the Bangsamoro (CAB) is likely to resolve the long-standing conflict between the GOP and the Moro separatist movements that date back to the 1960s. This study identifies why previous peace agreements between the GOP and rebel forces failed to achieve sustainable peace, and analyzes the extent to which the CAB addresses these failures. Specifically, this study compares the CAB to the 1976 Tripoli Agreement, the 1996 Final Peace Agreement, and the 2008 Memorandum of Agreement on Ancestral Domain. Though the CAB is still in the beginning stages of implementation, the effort by both groups toward making the agreement work suggests the likelihood of sustainable peace.

Keywords: Comprehensive Agreement on the Bangsamoro, Final Peace Agreement, Memorandum of Agreement on Ancestral Domain, Mindanao, Moro Islamic Liberation Front, Moro National Liberation Front, Tripoli Agreement

AIRMANSION ON THE GROUND: HOW THE AVIATION INDUSTRY CAN FUNDAMENTALLY CHANGE THE WAY FIRST RESPONDERS MANAGE COMPLEX EMERGENCIES
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Co-Advisor: Paul Smith, Department of National Security Affairs

Police and fire departments today are challenged with an increasing frequency of complex emergencies and a continuing cultural divide. Devoted people from both agencies are actively working to improve their response capability. Rather than solving the problem solely in house, other disciplines may be able to help. This thesis investigated what the aviation industry could teach the emergency services field about how to approach complex life-sensitive problems. A structured focused comparison model was used to evaluate aviation’s use of Crew Resource Management, the pre-flight briefing, and the concept of airmanship in relation to how they may benefit the response capability of police and fire commanders at a combined emergency response. The research concludes that police and fire departments in the United States would immediately benefit from instituting joint pre-shift briefings and discipline training. It is recommended that FEMA amend its ICS procedures to reflect the benefit of instituting a pre-shift briefing. By building relationships with a police or fire counterpart during briefings and showing discipline on an emergency scene, the public at large will immediately benefit.

Keywords: airmanship, police, fire, incident command system, ICS, collaboration, active shooter, complexity, aviation, crew resource management, unified command, chaos, police fire divide, emergency management, emergency response, complex emergency, discipline
This thesis investigates gaps in the credible fear process within the asylum context and provides recommendations for improving the process. As the number of individuals who file credible fear and asylum applications rises, the specter of individuals filing meritless applications increases. Applications for protection filed by criminals, terrorists, and opportunists threaten U.S. national security and public safety, and weaken the integrity of the nation’s asylum system. This thesis explores how the flaws in the asylum and credible fear process should be addressed to minimize fraud and abuse in the system. The findings of this thesis are that frivolous applications are being filed, and that criminals and terrorists are gaming the system. The research also concludes that current safeguards insufficiently protect the nation after an individual’s asylum approval. The author recommends the formation of an Asylum Review Board to provide additional layers of protection after an individual’s asylum claim is approved.

Keywords: Department of Homeland Security (DHS), U.S. Citizenship and Immigration Services (USCIS), Immigration and Customs Enforcement (ICE), Customs and Border Protection (CBP), Executive Office of Immigration Review (EOIR), asylum, credible fear, immigration

ASYMMENTRIC POWER BALANCE AND ITS IMPLICATIONS FOR REGIONALISM IN SOUTH ASIA
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It is widely believed that the regional dynamics in South Asia, characterized by power-asymmetry and geographical Indo-centricity, make the region a particularly brittle strategic environment. In that challenging context, this study seeks to determine why regional integration, including the creation of an important role for SAARC (South Asian Association for Regional Cooperation), has been so difficult in South Asia. The paper asserts that the power asymmetry between India and other South Asian countries has fueled an environment of regional discord, which has adversely affected regionalism in South Asia. The conflictual relationships, most prominent between India and Pakistan, have manifested in a regional mindset that is highly sensitive to state sovereignty and averse to the notion of relinquishing any degree of state sovereignty to a supra-national authority, which the European countries successfully accomplished. Such a mindset has made it difficult for South Asian countries to properly institutionalize the SAARC. The paper concludes that despite the setbacks, the prospects appear positive for regional integration in South Asia. But to achieve any meaningful traction in the integration process, the onus ultimately lies on SAARC members to change their attitudes vis-à-vis each other and soften their respective stances.

Keywords: asymmetrical power balance, regionalism, South Asia, South Asian Association for Regional Cooperation, European Union, Association for Southeast Asian Nations, supra-nationalism, state sovereignty, conflict
This thesis seeks to examine the concept of community fragility in emergency management from a systems perspective. Two questions are studied. First, can community fragility be qualitatively measured? Second, does this concept hold value for the emergency management field? Using literature that addresses fragility in four areas of complex systems—ecosystems, social systems, socio-technical systems, and complex adaptive systems—we create a theoretical framework focused on the emergency management field. This theoretical framework is then assessed through a multi-case analysis, examining three diverse large-scale events that have occurred in the United States in the past decade. Assessing each fragility factor from the theoretical framework for each case study reveals that the framework is sound. These findings allow for the development of a causal prediction model illustrating how community fragility factors can be used in the emergency management field to not only improve overall outcomes after disaster, but to also build less fragile systems and communities in preparation for future disasters.

Keywords: complexity, systems theory, systems, fragility, emergency management, socio-technical, social capital, resilience, vulnerability

Why have Yemen's counterinsurgency and counterterrorism polices been less effective against the Huthi movement compared to al Qaeda in the Arabian Peninsula (AQAP)? This paper finds that the military’s poor counterinsurgency and counterterrorism policies, the international effort to combat AQAP, the Huthi’s ability to recruit and mobilize large numbers of followers, and the Huthi leadership’s pragmatic alliances gave the Huthis the advantage over AQAP and the Republic of Yemen. Yemen faces multiple security problems. Foremost, the country faces threats from various groups, including the Huthi Movement, AQAP, Hirak, and tribal elements with the Huthis recently capturing Sanaa. The country’s oil supply will soon to run out, which is the main source of government revenue. The country is still in the process of transition required by the Gulf Cooperation Council-negotiated agreement after the Arab Spring. These problems are exacerbated by corruption, social, and economic problems. Finally, state failure remains a real possibility, with the various groups battling for control. In this case, Yemen could become the next Somalia. The worse scenario for the U.S. would for Yemen to become a safe haven for a group intent on attacking U.S. citizens and interests.

Keywords: Yemen, Saleh, counterinsurgency, counterterrorism, al Qaeda, AQAP, al Qaeda in the Arabian Peninsula, Houthi, Huthi, Ansar Shariah, Ansar Allah, believing youth, terrorism, insurgency, Arab Spring, Houthis, Huthis, Republican Guard, Sadah, Sadaa, Sanaa
Clausewitz believed that war and politics are inseparable—that the grim realities of war are just a continuation of the laborious machinations of politics. This relationship is always complicated. States are rarely able to achieve the complete destruction of their foes, settling instead on using their military might to achieve limited political ends. When political goals are pursued by inappropriate or ill-considered military means, disaster may easily result. For the United States 30 years ago, the decision to send combat troops into Lebanon in an ambiguous, peacekeeping role tragically illustrates one such disaster. This thesis examines the U.S. intervention in Lebanon from 1982–1984 to historically analyze U.S. policy and strategy and illustrate the disparities between the strategic goals of the administration and the methods employed to achieve them. These events mark the beginning of direct U.S. military intervention in the post-colonial Middle East, a process that has grown steadily in scale and consequence ever since. Despite the accumulation of such hard-won experience in the region, the harmonization of military means and political ends remains as illusive today as it was at the start.

Keywords: foreign policy, military strategy, historical analysis, Lebanon, intervention, foreign wars, conflict studies

THE IMPORTANCE OF THE EFFECTIVE UTILIZATION OF WOMEN AT ARMS
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Throughout history, humanity has perceived the military to be the domain of men. The reality is that this is a superficial perspective. Though the majority of combatants have always been male, there are numerous examples of women who have fought alongside, and even led, these men. Moreover, the female population has often been forced to endure some of the worst effects of war. As society has evolved toward democracy and embraced liberal values, the military world has increasingly been expected to align itself with principles of gender equality and protection of human rights. This need was recognized by the world community in 2000 when the United Nations passed UNSCR 1325, ensuring that women would become greater participants in conflict resolution. In the years since, NATO has also worked to encourage more female presence in its own ranks. This thesis studies the potential benefits to Ukraine’s armed forces that can be gained by increased female participation. To achieve this understanding, a thorough study of Civil-Military Relations and gender issues is conducted, along with an analysis of UN and NATO experiences in their respective attempts to boost the role of women in conflict zones. Finally, the current situation of servicewomen in Ukraine’s own armed forces is scrutinized in order to make recommendations for future policy.

Keywords: Ukraine, Gender Equality, Women at Arms, Female Peacekeepers, UNSCR 1325, Human Rights, Female Military Personnel, FET
Government agencies, businesses, and individuals alike have become more dependent on technology, and the desire and need for interconnectedness has led to increasing network vulnerability affecting both government and private sectors. Recognizing both government and private sector agencies individually lack the capabilities to defend against cyber threats, President Obama has called for a more robust and resilient cybersecurity alliance that encourages information-sharing partnerships with private sector owners and operators in charge of protecting U.S. critical infrastructure. Despite the recent drive for cyber legislation and policies, government agencies and private companies have seemed reluctant to share information related to cyber-attacks and threats with one another. To discover the deeper underlying issues that inhibit public-private cooperation, and to evaluate the effectiveness of public-private partnerships (PPPs) to advance cyber information sharing, this thesis examines the banking and finance sector of U.S. critical infrastructure sector. In doing so, it identifies reasons why information-sharing problems exist between government agencies and private companies; investigates how PPPs satisfy national cybersecurity needs; and, in turn, reveals issues for policymakers to consider when shaping policies that encourage an open dialog between the public and private sector.

Keywords: cybersecurity, public–private partnerships, critical infrastructure, cyber-attacks

This paper has been recognized as an outstanding thesis by its department.

This thesis explores the influence of culture on the requirements for a Revolution in Military Affairs (RMA). It assesses how cultural factors at the strategic and the U.S. Army organizational levels may affect the changes required for realizing an RMA. Defined as a paradigmatic shift in the conduct of military affairs spurred by the confluence of organizational change with new and existing technologies and concepts of operations, the RMA has long been a controversial analytical construct. This thesis accepts the premise that the history of warfare can be interpreted as a series of RMAs. It explores the complex and powerful influence of American strategic culture and the organizational culture of the U.S. Army on the organizational, doctrinal, technology, funding and other factors vital to the realization of an RMA. The thesis compares the influence of U.S. strategic and Army organizational culture on the RMA during the interwar period (1919–1941) and the contemporary period (since the 2011 withdrawal of U.S. combat forces from Iraq) to highlight similarities and differences that U.S. military and civilian leaders can learn from to change the paradigm of military affairs in America's favor.

Keywords: revolution in military affairs (RMA), strategic culture, organizational culture, interwar era, strategic net assessments, national cognitive style
SECURITY STUDIES

NATIONALISM: THE MEDIA, STATE, AND PUBLIC IN THE SENKAKU/DIAOYU DISPUTE
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Master of Arts in Security Studies (Far East, Southeast Asia, and the Pacific), 2015
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Since diplomatic normalization in 1972, Sino-Japan relations have hit a new low due to escalating military and diplomatic confrontation around the islands in the East China Sea, known as the Senkaku in Japan and the Diaoyu in China. Through a comparative media analysis of the dispute, this thesis considers the extent to which China and Japan are instrumentally influencing nationalist rhetoric in the media in order to advance state interests. Media analysis indicates a pattern of rising nationalist rhetoric in both Japan and China over the 23-year period from 1990 to 2013. Contextual analysis of historical events also suggests that both China and Japan have used the dispute instrumentally to bolster domestic support while attempting to manage nationalist rhetoric in order to prevent negative international consequences. However, due to popular nationalism transforming journalistic and political consensus, Tokyo’s influence over the media in Japan declined steeply after 2010. In China, the state maintains strict oversight over the media and public mobilizations, but Beijing may also be slowly losing its control over popular nationalism. In sum, popular nationalism may be growing beyond state control, limiting political options to improve bilateral relations for both Chinese and Japanese leaders.

Keywords: nationalism, Senkaku, Diaoyu, media, Sino-Japanese relations, state control of media, public influence in media

WINNING THE HEARTS AND MINDS: IMPROVING U.S. COUNTER-RADICALIZATION EFFORTS THROUGH A STUDY OF THE UNITED KINGDOM’S PREVENT STRATEGY
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Advisor: Paul Smith, Department of National Security Affairs
Co-Advisor: Lauren Wollman, Center for Homeland Defense and Security

Warfare in the 21st century has matured to the point where military technology and force are no longer the keys to victory. Today’s warfare has become a war of ideas. Success in war now means winning the hearts and minds of citizens to prevent them from becoming radicalized. The research question posed is how can the United States effectively fight the war of ideas, and can it develop its own counter-strategic strategy? Utilizing the case study method aspects of the United Kingdom’s counter radicalization PREVENT strategy were examined. Based on this research, a U.S. policy model is proposed where the United States develops its own counter-radicalization strategy. The findings of this research show that a U.S. counter-radicalization strategy should be implemented. However, it would be carried out at the local level (i.e., mayor’s offices and/or governor’s offices). It will require the coordinated effort of several federal agencies to establish programs to address radicalization factors. The findings propose that this coordination be carried out by an appointed counter radicalization czar through the Department of Homeland Security. The czar would have intra-departmental authority to coordinate federal agencies to promote and provide programs that address counter radicalization factors that make individuals susceptible to the terrorist message.

Keywords: counter radicalization, radicalization, UK PREVENT strategy, United Kingdom, Muslim, war of ideas, al-Qa’ida, propaganda, winning hearts and minds, case study, research and information communications unit, center for strategic counterterrorism communication
THE TROUBLED RELATIONSHIP BETWEEN ISRAEL AND THE EUROPEAN UNION: AN EMPIRICAL EXPLANATION
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Advisor: James Russell, Department of National Security Affairs
Second Reader: Zachary Shore, Department of National Security Affairs

A peaceful resolution to the Arab-Israeli Conflict has eluded the international system for sixty-seven years. As time passes, insoluble physical and political conditions in the region risk the achievement of a lasting peace. Standing in the way is the European Union’s (EU) tempestuous relationship with Israel. In order to forge a peaceful settlement of the conflict an understanding of EU foreign policy toward Israel is necessary. This thesis seeks to explain the permissive cause of EU foreign policy toward Israel using the case study of the Arab-Israeli Conflict between 1973 and 2010. In the context of the Arab-Israeli Conflict, three widely held international relations theories that demonstrate explanatory power for EU foreign policy are realism, constructivism, and liberalism. The case study illustrates, however, that in conformance with the principles of liberal internationalism EU foreign policy with respect to Israel is framed around the tenets of democracy, interdependent economic systems, and the employment of international institutions, which explains the volatile nature of the bi-lateral relationship. While the EU engages Israel with the breadth of its institutions and pursues an enduring economic relationship, Israel’s occupation of the Palestinian territories, perceived human rights violations, and settlement activity violate European democratic truths and strain the relationship.

Keywords: European Union, EU, Israel, Palestine, Palestinian Liberation Organization, Palestinian Authority, Arab-Israeli Conflict, Israeli-Palestinian Conflict, Middle East Peace Process, realism, constructivism, liberalism

REGIONALISM AND SECESSION
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Co-Advisor: Donald Abenheim, Department of National Security Affairs

Catalonia and Bavaria today cling tightly to their linguistic distinctiveness, their cultural traditions, their culinary specialties, and their political particularity. Even after the passage of some centuries, these regions have not yet amalgamated into the nation states that contain them. And yet, Bavaria’s stubborn regionalism does not translate into any real longings for secession, whereas many Catalonians struggle actively and adamantly for autonomy. Why are there strong independence movements in Spain, but not in Germany? How have state formation and the relationship between the center and the region affected independence movements? This thesis provides a historical analysis of Bavarian and Catalan regionalism and argues that autonomy mitigates secession if the predominant state has accommodated sub-state regionalism. This thesis explains that the EU can either strengthen or weaken regional governments, depending upon the nature of the relationship between the regional governments and their associated national government. This thesis argues that the security of both a newly independent state and its parent government is worse off in the short term; the severity of the security situation depends on the nature of the divorce.

Keywords: nationalism, secession, regionalism, EU, NATO
THE LIMITS OF THE ASEAN REGIONAL FORUM
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Advisor: Michael Malley, Department of National Security Affairs
Second Reader: Tristan Mabry, Department of National Security Affairs

Since the end of the Cold War, Asia has faced many traditional and non-traditional security challenges. These challenges include increasing Chinese assertiveness, territorial disputes among multiple Asian states in the East and South China Seas, the buildup of North Korea’s nuclear arsenal, the discovery of terrorist networks in Southeast Asia, and several major natural disasters and humanitarian crises. Each of these revealed an apparent lack of cooperation and coordination among countries in the region, but each seems to have spurred the creation or development of new regional institutions. The Association of Southeast Asian Nations (ASEAN) initiated the formation of the ASEAN Regional Forum (ARF), a cooperative security arrangement with the stated objectives to progress from confidence building measures to preventive diplomacy and conflict resolution. The usefulness of the ARF, however, continues to be hotly debated by analysts, who generally find the ARF to be limited in its ability to resolve Asia’s security challenges. These arguments, however, overlook the fact that the forum has fostered practical cooperation in addressing certain kinds of security challenges. What are the ARF’s limits in responding to Asia’s traditional and non-traditional security challenges? The thesis uses contemporary case studies to analyze the ARF’s limits. These case studies focus on the ARF’s responses to traditional and non-traditional security challenges. In so doing, the thesis recognizes that the ARF is unable to resolve traditional security issues or stage operational responses to non-traditional security issues. It argues, however, that the ARF is far from being irrelevant. The forum brought regional players together in constructive dialogues and fostered practical security cooperation in specific non-traditional security issues.

Keywords: ASEAN regional forum, ASEAN Defense Minister Meeting Plus, South China Sea, traditional security challenges, non-traditional security challenges, counter-terrorism, humanitarian assistance and disaster relief

FINDING THE WOLVES IN SHEEP’S CLOTHING: WAYS TO DISTINGUISH AND DETER LONE-WOLF TERRORISTS
Walter Lee—Lieutenant, United States Navy
Master of Arts in Security Studies (Homeland Security and Defense), 2015
Advisor: Erik Dahl, Department of National Security Affairs
Second Reader: Carolyn Halladay, Center for Civil–Military Relations

Despite the rise in the number of attacks by lone-wolf terrorists, the lone-wolf threat has largely been neglected by academic researchers and counterterrorism practitioners. The nature of the lone-wolf terrorist has introduced new challenges to law enforcement and counterterrorism unlike the more discussed problems of international group terrorism. This thesis suggests, however, that policies created to help deter group terrorism could be useful in detecting and deterring lone-wolf terrorists. The existing policy framework for group terrorism deterrence may have great utility in the fight against lone wolves, but policy use and effectiveness requires a careful examination of the characteristics unique to lone-wolf terrorism to ensure that the deterrence policies match. This thesis uses the comparative method and examines three case studies of lone-wolf terrorism from the United States and Europe: the Fort Hood shooter of 2009 (Major Nidal Hasan), the Boston Marathon bombers, and Anders Behring Breivik of Norway. By examining the unique circumstances of each case, this thesis determines what policies were and were not effective and in need of adaptation to deter the threat of lone-wolf terrorism.

Keywords: lone-wolf terrorism, counterterrorism, Nidal Hasan, Boston Marathon bombing, terrorism, Anders Breivik
THE RELATIONSHIP BETWEEN ISLAMISM AND WOMEN IN CIVIL SOCIETY: A LOOK AT TURKEY AND EGYPT
Katherine Lockhart–Captain, United States Air Force
Master of Arts in Security Studies (Middle East, South Asia, Sub-Saharan Africa), 2015
Advisor: Anne Marie Baylouny, Department of National Security Affairs
Second Reader: Ryan Gingeras, Department of National Security Affairs

In the lead up to the 2001 invasion of Afghanistan, the U.S. government emphasized how the military intervention would liberate Afghani women from the Taliban, echoing an old colonial discourse that Muslim women need saving. This study reviews the effects of Islamism, especially when it influences political decisions, on women. In particular, the study focuses on whether there is a correlation between rising Islamism and women in civil society in Turkey and Egypt through the variables of political, educational, and employment opportunities.

Keywords: political Islam, women, women in Egypt, women in Turkey, education, employment, political opportunities

U.S. STRATEGIC INTERESTS AND GEORGIA’S PROSPECTS FOR NATO MEMBERSHIP
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Master of Arts in Security Studies (Europe and Eurasia), 2015
Advisor: David Yost, Department of National Security Affairs
Second Reader: Mikhail Tsypkin, Department of National Security Affairs

Many observers in NATO and European Union (EU) countries hold that Russia is attempting to challenge the increasing Western influence in Central and Eastern Europe and reassert itself as a regional and global superpower. The 2008 Russia-Georgia conflict and the ongoing crisis in Ukraine provide evidence in support of this theory. Twelve Central and Eastern European nations have nonetheless joined NATO since 1999, and others have pledged their membership aspirations. This fact alone suggests that a general fear of Russian aggression persists among Central and Eastern European nations, and that NATO enlargement is both justified and welcomed. This thesis examines Georgia’s prospects for NATO membership and assesses U.S. strategic interests in this regard. To accomplish this, this thesis analyzes Georgia’s geostrategic importance and investigates links between Georgian and U.S. foreign policies as they relate to NATO enlargement. As regards Georgia, the key questions concern the extent to which the United States supports Tbilisi's candidacy for Alliance membership, and whether the United States and its NATO Allies are willing to accept the risks and responsibilities that would be incurred with Georgia's NATO membership. This thesis concludes that U.S. decisions regarding Georgia’s candidacy for NATO membership will be of critical importance.

Keywords: Georgia, Tbilisi, Abkhazia, South Ossetia, NATO, NATO enlargement, partnership for peace, PfP, international partnership action plan, IPAP, annual national program, ANP, planning and review process, PARP, membership action plan, MAP, NATO–Georgia Commission

IMPROVING EMERGENCY MANAGEMENT BY MODELING ANT COLONIES
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Master of Arts in Security Studies (Homeland Security and Defense), 2015
Advisor: Erik Dahl, Department of National Security Affairs
Second Reader: Glen Woodbury, Department of National Security Affairs

The focus of this thesis is to identify whether emergency management can be modeled after ant colonies, perfectly emergent organizations, in order to better manage an autonomous response. An ant colony uses a dense and resilient communications system that incorporates a positive feedback loop, which allows the organiza-
tion to be adaptable. Currently, emergency management organizations are experimenting with social media to establish a communications system similar to the positive feedback loop used by ant colonies. This thesis advocates that following a disaster, an emergency management organization gather information from the public through an Internet survey. The survey would be quickly processed and provide critically needed information.

Keywords: emergency management, ants, communications system, emergence, social media

OFFENSE-DEFENSE THEORY ANALYSIS OF RUSSIAN CYBER CAPABILITY

This paper has been recognized as an outstanding thesis by its department.

Sergei Medvedev—Major, United States Air Force
Master of Arts in Security Studies (Europe and Eurasia), 2015
Advisor: Wade Huntley, Department of National Security Affairs
Co-Advisor: Mikhail Tsypkin, Department of National Security Affairs

The Russian Federation is a key state actor in cyberspace; cyber events associated with Russian state and non-state actors have threatened Russia’s neighbors, shaped international cyber norms, as well as influenced strategists’ understanding of cyber power. This thesis seeks to understand Russian cyber capability through the lens of Robert Jervis’s offense-defense theory in order to answer the thesis’s central question: Do Russian cyber capabilities reflect an investment in offensive or defensive cyber weapons, and do Russia’s cyber technology, doctrine, and policy differentiate its posture as offensive or defensive? To evaluate Russian cyber capability, this thesis considers two factors—technology and geography—concluding that, although the Russian government is modifying its cyber terrain to improve defensiveness, Russia’s brandished cyber weapons suggest that it pursues offensive capability. To evaluate Russia’s posture differentiation, the thesis examines Russians’ understanding of cyber power, Russian information warfare and hybrid warfare doctrines, and the country’s international engagements, concluding that, although Russia has historically presented its posture as defensive, it is increasingly difficult to make that distinction. Finally, the thesis evaluates this state-level analysis in the broader context of the international system; Russia’s historical aggression and current behavior in cyberspace likely reflects Stephen van Evera’s explanatory hypothesis for the causes of war—defensive expansion.

Keywords: Russia, cyber, cyberspace, offense-defense theory, information warfare, hybrid warfare

FIGHTING NARCOTRAFFIC IN LATIN AMERICA: MEXICO AND EL SALVADOR—A COMPARATIVE APPROACH

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Master of Arts in Security Studies (Civil-Military Relations), 2015
Advisor: Ryan Gingeras, Department of National Security Affairs
Second Reader: Thomas Bruneau, Department of National Security Affairs

Mexico and El Salvador have been fighting organized crime for decades. While Mexico has fought drug cartels with the support of the U.S. government, El Salvador has struggled to lower high crime rates mostly with its own resources. Mexico, which has a different government structure from El Salvador’s, has not been able to control drug trafficking despite the use of armed forces. Although Mexico’s approach to fighting drug cartels differs from El Salvador’s approach, neither country has been able to control organized crime in its own territory. While both countries have used armed forces, the outcomes vary. Mexico achieved partial success by incarcerating drug cartel leaders and seizing drugs; however, drug trafficking continued. El Salvador’s use of armed forces has been limited, and the strategy did not lower high crime rates. Human rights issues have
aroused negative attention to both countries. The magnitude of the criminal activity in both countries requires a more comprehensive approach, rather than the use of armed forces to counter criminal organized crime.

Keywords: El Salvador, Mexico, organized crime, gangs, drug trafficking, public security institutions, policy, criminality

PREEMPTING MASS MURDER: IMPROVING LAW ENFORCEMENT RISK ASSESSMENTS OF PERSONS WITH MENTAL ILLNESS

This paper has been recognized as an outstanding thesis by its department.

John Milby—Captain, Douglas County Sheriff’s Office, Minden, NV
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Co-Advisor: Patrick Miller, Center for Homeland Defense and Security

Across the United States, mass murder events have been on the rise for nearly a decade. This thesis found that persons with serious mental illness perpetrated a statistically significant number of these events. Currently, law enforcement agencies are often the first—and in many communities the only resource—available to assist and assess mentally ill persons in crisis. This thesis investigated the current state of law enforcement training as it relates to assessing dangerousness and the risk for violence among persons with serious mental illness. It found that there is very little training and no risk assessment tool or guide currently available to assist law enforcement officers tasked with assessing mentally ill persons for dangerousness. Subsequently, this thesis examined alternative methods and models for assessing risk, including clinical violence risk assessments, and it conducted summary case studies. These included cases in which mentally ill persons committed acts of mass murder and cases where law enforcement successfully intervened and prevented mentally ill persons from carrying out planned violence. As a result of this research and analysis, a field risk assessment guide has been developed and recommended for adoption to aid law enforcement officers in assessing the dangerousness of mentally ill persons.

Keywords: mental illness, serious mental illness, violence, dangerousness, involuntary civil commitment, law enforcement, mass murder, risk assessment, clinical violence risk assessment, behavioral threat assessment, active shooter, crisis intervention teams

SYRIA AND THE RISE OF RADICAL ISLAMIST GROUPS

This paper has been recognized as an outstanding thesis by its department.

Creighton Mullins—Major, United States Air Force
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The Syrian uprising began as a secular, nationalist struggle in 2011 but gradually devolved into a vortex of sectarian warfare with more than 200,000 dead and another 10 million displaced. Amid the chaos, the radical Sunni Islamist groups Ahrar al-Sham, Jabhat al-Nusra, and the Islamic State became the most prominent in the conflict. This thesis explores why and how the groups emerged in Syria, rose to power, and proliferated to unprecedented levels by tracing the progression of the Syrian conflict through three cycles of contestation: protest, insurgency, and civil war. Combining elements from social movement, insurgency, and radicalization theories as well as civil war literature, this thesis dissects the radical Islamist ideology, the institutional legacies from prior struggles, and the role of external sponsors; and places each in the context of the Syrian conflict. History has proven that the radical Islamists fighting in Syria today are the next generation of leaders in the global jihad movement. Understanding their rise to power provides crucial insight to our future enemies. This
thesis seeks to go beyond a recitation of facts and links multiple frameworks with the rise of the most powerful radical Islamist groups in the Syrian conflict.

Keywords: Syria, social movement theory, insurgency theory, radicalization theory, civil war, Islamic State, Ahrar al-Sham, Jabhat al-Nusra, al-Qaeda, terrorism, Islamic fundamentalism, global jihad movement

STRATEGIES OF SUCCESSFUL POVERTY REDUCTION: CASE STUDIES OF TANZANIA AND ZAMBIA
Jacqueline Natter–Lieutenant Commander, United States Navy
Master of Arts in Security Studies (Middle East, South Asia, Sub-Saharan Africa), 2015
Advisor: Robert Looney, Department of National Security Affairs
Co-Advisor: Naazneen Barma, Department of National Security Affairs

While both Tanzania and Zambia have experienced significant economic growth in the 21st century, Tanzania has been able to translate that growth into poverty reduction while Zambia has not. A contextual picture of the two countries’ economic growth trajectories is provided, with an emphasis on understanding how specific policies and changes in their governance have affected growth, poverty reduction, inequality, and overall development. After considering each respective country’s economic growth and constraints, the effectiveness in translating that growth into development, as espoused through national poverty reduction strategies, is reviewed.

Keywords: economic growth, poverty reduction, economic development

BEYOND MEASURE: NEW APPROACHES TO ANALYZING CONGRESSIONAL OVERSIGHT OF HOMELAND SECURITY
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This paper will explore the implications of congressional oversight of homeland security, specifically the Department of Homeland Security (DHS). Oversight of DHS has been extensively researched since the 9/11 Commission recommended that it be reformed. This thesis argues that much of the previous research into this topic relied on a limited view of oversight and used a limited set of tools to measure it. This thesis reviews the existing literature on homeland security oversight and offers alternative ways of measuring oversight. It conducts two case studies to establish a more complete view of homeland security oversight. Then, it quantitatively analyzes legislative data and offers a new approach to using agency interactions to provide a more meaningful picture of homeland security oversight. Finally, the thesis offers recommendations based on the conclusions of the research to achieve optimal congressional oversight of homeland security.

Keywords: homeland security, Department of Homeland Security, oversight, congressional oversight, Congress, 9/11 Commission, policy recommendations, social network analysis, legislation
GENDER EQUITY: WOMEN'S POLITICAL EMPOWERMENT IN SOUTH KOREA
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South Korea has undergone many drastic transformations from the time the state formally emerged in 1948 until now, becoming a thriving democracy and the world's 12th-largest economy. Women in South Korea have enjoyed many aspects of this recovery and rise. According to the 2013 World Economic Forum's Annual Gender Gap Index, South Korea's women today have the highest literacy and healthy life expectancy rates in the world. Yet according to the same index, South Korea placed 111th out of 136 countries in gender equality. While this index highlights the need for further improvement, the ranking does not illustrate the whole story of how far Korean women have progressed in their political empowerment. Conventional measurements describe Korean women's political empowerment status as unfavorable, but closer examination paints a different picture. Increasing economic status, higher education, and strengthening social capital have allowed Korean women to be more involved in civic life, and as a result, to make greater demands for equal representation in politics. All of these factors suggest a trend of continuous progress toward increased political empowerment.

Keywords: South Korea, political representation, women's empowerment, gender gap, gender inequality

ASSESSING TECHNOLOGY INNOVATION IN THE PLA
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Advisor: Wade Huntley, Department of National Security Affairs
Co-Advisor: Michael Glosny, Department of National Security Affairs

In the last 10 years, China's defense capability has increasingly become the focus of military analysts as well as a driving factor in U.S. policy. This thesis asks the question How much of Chinese military modernization counts as innovation? In answering this question it defines innovation, creates a standard for identifying innovation, and applies this standard to the plan and plaAF. Historically, technological innovation is either overlooked or ignored by intelligence services and recent developments by China have come as a surprise to many. This thesis identifies a total of 79 instances of innovative technology fielded by the plan and the plaAF since 1970. Many of these innovations, like the DF-21D, PL-12, and recent JY series of radars, comprise weapon systems not yet developed by other nations and thus count as global-level innovations. China is focused on developing innovative technologies to exploit weaknesses inherent in other technologically superior forces such as those fielded by the United States in order to gain an asymmetric advantage in what Chinese strategists label a counter-RMA.

Keywords: China, Chinese, innovation, technology, military, modernization, Navy, air force, defense, pla, A2AD, asymmetric, counter-RMA
THE EVOLUTION OF THE MEXICAN MILITARY: FROM THE MEXICAN REVOLUTION IN 1910 TO 2014
Rigoberto Pérez—Captain, United States Air Force
Master of Arts in Security Studies (Western Hemisphere), 2015
Advisor: Rodrigo Nieto-Gómez, Department of National Security Affairs
Second Reader: Daniel Moran, Department of National Security Affairs

This thesis provides a longitudinal review of the Mexican military’s relationship with the state. From 1910 to 2014, the events, rhetoric, and geopolitical representations of the Mexican revolution are assessed in terms of the resulting changes to the military’s mission, role, and organization. The research identifies the revolutionary influence that still remains after the seventy-one year rule of the PRI. Additionally, it discusses some of the historical effects of civilian control within the institution and how the military is controlled under legislative rule today. Furthermore, it provides a review of military policy through the peaceful transition from the Institutional Revolutionary Party, referred as the PRI (Partido Revolucionario Institucional), to the National Action Party, referred as the PAN (Partido Acción Nacional), and back to the PRI in 2012. Finally, it discusses the contemporary Mexican military in terms of how its loyalty and professionalism will propel it into the international scene despite the human rights violations.

Keywords: Mexican military, Mexican armed forces, Mexican revolution, SEDENA, SEMAR, PRI, PAN, Vicente Fox, Felipe Calderón, Enrique Peña Nieto, objective civilian control, subjective civilian control, military policy, human rights

STATE DEFENSE FORCES AND THEIR ROLE IN AMERICAN HOMELAND SECURITY
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Second Reader: Carolyn Halladay, Center for Civil-Military Relations

State Defense Forces (SDFs), or organized state militias and naval militias, have a long and distinguished history of service in the United States. These state-sanctioned organizations are substantiated and legitimized through the U.S. justice system and constitutional law. Currently, 23 states and U.S. territories have SDFs; unlike National Guard units, they cannot be federalized, which means they remain a state-level asset during emergency management operations. SDFs were utilized successfully during Hurricane Katrina, proving their value in state and federal emergency response efforts. This thesis seeks to analyze the structure and usefulness of the SDF as a volunteer emergency response organization. Second, it seeks to understand the evolution of the SDF by examining U.S. militia history. Third, it examines the disaster-relief efforts of SDFs with regard to Hurricane Katrina. SDFs provide state governors with emergency response personnel who are locally available and ready to serve in multiple capacities. Presently, state officials can promote legislation and develop a mission-flexible State Defense Force that can act as a reserve force for local law enforcement and the National Guard during natural and man-made disasters. The SDF may be the next step in the evolution of state and local emergency response in the 21st century.

Keywords: state defense forces, homeland security
this thesis analyzes the state of civil-military relations and militarization in El Salvador under the leadership of President Mauricio Funes (2009–2014). Civil-Military Relations are examined using the Center for Civil-Military Relations trinity framework—first proposed by Thomas C. Bruneau in the journal Revista Fuerzas Armadas y Sociedad in 2005—which considers effectiveness, efficiency, and democratic civilian control. Militarization is presented in terms of Salvadoran troops in the streets. This thesis presents the linkage of these two phenomena as domestic security policy formation and implementation. The analysis demonstrates that informal Civil-Military Relations have resulted in a largely undemocratic response to El Salvador’s sizeable security challenges. Two cases, in particular, are studied more closely: 1) President Funes’ unique relationship with General David Munguía Payés and 2) the government’s secret design of the 2012 gang truce. This thesis concludes that security policy formation under the Funes administration was haphazardly conducted as an expedient to El Salvador’s security dilemma and resulted in at least a partial democratic breakdown in the processes envisioned by the 1992 peace accords.

Keywords: El Salvador, militarization, civil-military relations, Mauricio Funes, Salvador Cerén, David Munguía Payés, FMLN, gang truce

THE ROLE OF CIVIL SOCIETY IN SHAPING DEMOCRATIC CIVIL-MILITARY RELATIONS DURING POLITICAL TRANSITION IN NEPAL
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Co-Advisor: Florina Cristiana Matei, Center for Civil-Military Relations

This thesis examines the role of civil society in shaping democratic Civil-Military Relations (CMR) through several political transitions in Nepal, with an emphasis on the current period. Since its first experience with democracy in 1950, the king interrupted Nepal’s pursuit of consolidation until the political revolution of 2006; afterwards, democratic consolidation at the official level has revolved around seeking consensus among the political leaders. This over-focus has led to incomplete consolidation and weakened the formal democratic institutions of control. Civil society, on the other hand, has played a variety of roles to greater effect during consolidation, including military affairs and CMR. This thesis analyzes the contributions of three selected civil society groups—the media, Nagarik Samaj, and human rights organizations—to democratic civilian control of the security forces. This thesis finds that despite civil society’s focus on political activities, it has significantly influenced and helped in shaping effective democratic CMR during Nepal’s transition to democracy. However, civil society’s further assistance is required in writing the constitution to drive the country toward the completion of the consolidation, which will ultimately shape strong democratic CMR.

Keywords: Nepal Army, Civil-military relations, civil society, democratic civilian control, democratic consolidation, civilian authorities, political leadership, military control, democratic control mechanisms, republic, monarchy, Maoist insurgency, conflict
THE LESS YOU KNOW: THE UTILITY OF AMBIGUITY AND UNCERTAINTY IN COUNTER-TERRORISM

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Terrorism is a complex issue without any clear or simple solutions. Much of the problem space around counter-terrorism is amorphous, and most of the vast literature attempting to impose clarity on terrorism studies fails to do so. This thesis takes a different approach by exploring how ambiguity and uncertainty might be leveraged as a tool for Western liberal democracies in the fight against terrorism. Strategies of Cold War nuclear deterrence are examined and specific instances of the advantages of uncertainty are identified. Ambiguity and uncertainty are defined and described in detail, and examples of how they might be used are discussed. This thesis concludes that greater terror threats warrant greater use of strategies employing uncertainty on the part of one’s enemies and oneself.

Keywords: counter-terrorism, uncertainty, ambiguity, deterrence

HUMAN TRAFFICKING IN SOUTHEAST ASIA AND U.S. NATIONAL SECURITY

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Second Reader: Tristan Mabry, Department of National Security Affairs

The United States government finds human trafficking to be an important subject and is placing increasing focus on the issue. The Southeast Asian portion of the Western Pacific encompasses a substantial portion of global trafficking, much of which has a final destination in the United States. This thesis asks the following question: How does trafficking in persons (TIP) affect U.S. national security interests and regional stability in Southeast Asia? To answer this question, this thesis examines how trafficking affects U.S. national security; the importance of combatting human trafficking in Southeast Asia to regional stability and to U.S. national security; levels of involvement the United States might seek to address the problem of human trafficking in Southeast Asia; and the possibility of an increase in maritime security efforts and interagency coordination in Southeast Asia to effectively combat human trafficking. U.S. national security is tied to regional stability through effects on economic interdependence and state partnerships. TIP threatens both, through its influence in transnational organized crime and the misuse of humans as an illegal resource. The thesis concludes by considering possible solutions to the problem that could be adopted by the United States military.

Keywords: Southeast Asia, human trafficking, trafficking in persons, transnational organized crime, national security

CIVIL SOCIETY IN NIGERIA: REASONS FOR INEFFECTIVENESS

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Co-Advisor: Robert Looney, Department of National Security Affairs

Nigeria has experienced high economic growth over the last 15 years. Hailed as the Giant of Africa, the Economist confirmed in 2014 that Nigeria had the largest gross domestic product in the continent. Yet, after more than a decade of sustained growth using international metrics of measurement, the country has exhibited dismal performance across multiple measures of development, security, and democratic governance due to the
mismanagement of its economic resources. The majority of Nigerians attest to this in successive Afrobarometer Network and Transparency International surveys conducted between 2008 and 2014. This thesis acknowledges these facts but draws the reader into an equally important exploration of the role of the masses and civil society in engendering democratic governance. The underlying premise is that civil society can play a role in facilitating representative governance, especially as it relates to service delivery and the Nigerian populace's security. The thesis posits that civil society has been handicapped in its ability to fulfill this charter for three distinct reasons: weakened traditional institutions; lack of social capital and trust between the masses, civil society, and the state; and the detrimental impact of a primarily oil- and mineral-based economic model. These factors all hinder the government's willingness to work toward the best interest of the society as a whole.

Keywords: Nigeria, civil society, corruption, traditional institutions, social capital, trust, economic, citizen, state

EURASIANISM: A HISTORICAL AND CONTEMPORARY CONTEXT
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Advisor: Mikhail Tsypkin, Department of National Security Affairs
Second Reader: Victoria Clement, Department of National Security Affairs

Since the fall of the Soviet Union Russia has yet to implement an effective state ideology to endear the state to its people. Eurasianism could provide a possible solution for the state as a concept that places Russia in a unique place between Europe and Asia rather than a part of either Europe or Asia. This thesis analyzes the concept of Eurasianism, its origins, its most prolific modern proponent, and the potential for a state-sponsored Eurasianist ideology. Eurasianism itself focuses on a unique role for Russia in the realm of international affairs. This concept, in turn, provides a form of Russian exceptionalism to its people. The Russian state can theoretically use such an ideology to provide a coherent argument against Westernization and liberal economic reforms in order to maintain control of the country. Furthermore, the concept of Eurasianism can also serve as a means to provide Russians with a sense of Great Power status in line with that of the former Soviet Union.

Keywords: Eurasianism, Alexander Dugin

THE DILEMMA OF COMBATING TERRORISM IN DEMOCRATIZING STATES: A CASE STUDY OF THE REPUBLIC OF UGANDA
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Advisor: Carolyn Halladay, Center for Civil-Military Relations
Co-Advisor: Florina Cristiana Matei, Center for Civil-Military Relations

This thesis analyzes the dilemmas that both democratic and democratizing states face while dealing with terrorism-related problems. This problem has been equally pressing to a country like Uganda because it has been experiencing the problem of terrorism while undergoing the process of democratization. Much of the discussion boils down to whether and at what point forceful measures against terrorism protect or imperil the democracy. The challenge is how to balance counterterrorism measures and uphold democratic principles. The thesis discusses various approaches and experiences used by democratic states, using the United States and the United Kingdom as examples in tackling the problem of terrorism. From a policy perspective, immediately after 9/11, leaders from the United States and the United Kingdom introduced broad new authorities and legal measures in such laws as the U.S. Patriot Act and The Anti-Terrorism Crime and Security Act of 2001 of the UK. Using the experiences of these countries, Uganda adopted similar approaches by introducing the Anti-Terrorism Act of 2002, through which counterterrorism efforts have been handled. This study
concludes by identifying some of the contradictions brought about by the new policies and examining their impact on both developed democracies and democratizing states like Uganda.

Keywords: Uganda, terrorism, counterterrorism, anti-terrorism, democratization, African security, legal framework, Great Lakes regional security

VIOLENT CRIME IN POST-CIVIL WAR GUATEMALA: CAUSES AND POLICY IMPLICATIONS
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Master of Arts in Security Studies (Western Hemisphere), 2015
Advisor: Thomas Bruneau, Department of National Security Affairs
Second Reader: Florina Cristiana Matei, Center for Civil-Military Relations

Guatemala is one of the most violent countries in Latin America, and thus the world. The primary purpose of this thesis is to answer the following question: what factors explain the rise of violent crime in post-civil war Guatemala? The secondary focus of this thesis is to identify the transnational implications of Guatemala’s violence for U.S. policy. Guatemala’s critical security environment requires the identification of causal relationships and potential corrective actions. This thesis hypothesizes that the causes of violent crime in post-conflict Guatemala are the combination of weak institutional performance and social factors. Determining that Guatemala is not a consolidated democracy, this thesis concludes that a flawed judicial system, inadequate police reform, and weak civil control over the armed forces have a direct causal effect on violent crime in Guatemala. Furthermore, an analysis of social factors demonstrates that these are not causal in nature but rather influential elements in the occurrence of violence.

Keywords: Guatemala, post-conflict, violent crime, drug trafficking, violent gangs, social cleansing, lynch law, femicide, corruption, democratic consolidation, institutional capacity, judicial system, police reform, Civil-Military Relations, social factors

A COMPREHENSIVE FUSION LIAISON OFFICER PROGRAM: THE ARIZONA MODEL
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Master of Arts in Security Studies (Homeland Security and Defense), 2015
Advisor: Lauren Wollman, Center for Homeland Defense and Security
Co-Advisor: Patrick Miller, Center for Homeland Defense and Security

Many of the fusion centers recognized by the U.S. Department of Homeland Security have established a liaison officer program with the intent of sharing information. In Arizona, the Arizona Counter Terrorism Information Center’s Terrorism Liaison Officer (TLO) Program has become an institution that is relied upon by participant jurisdictions for intelligence and information sharing between federal, state and local governments, along with unifying critical infrastructure initiatives and responding to major events. The network provides professional and vetted-out partners throughout the public safety community to assist jurisdictions in addressing many high-risk events and incidents. In the Phoenix urban area, TLOs respond to moderate and large scenes to support incident commanders with critical infrastructure data, a law enforcement intelligence research capability and a fire/emergency medical service/hazardous materials coordination capability that did not exist prior to the TLO program’s establishment. The Arizona Counter Terrorism Information Center’s TLO program can serve as a model for fusion centers by demonstrating how multilayered and multijurisdictional relationships can be leveraged into a comprehensive network to address complex issues.

Keywords: fusion center, liaison officer, responder, Homeland Defense Bureau (HDB), terrorism liaison officer (TLO), Arizona Counter Terrorism Information Center (ACTIC), intelligence liaison officer (ILO)
SECURITY STUDIES

BARRIERS TO COMBATING HUMAN TRAFFICKING IN COLOMBIA

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Advisor: Rodrigo Nieto-Gómez, Department of National Security Affairs
Second Reader: Maiah Jaskoski, Department of National Security Affairs

Despite international and domestic policies and programs intended to combat human trafficking, Colombia remains one of the countries with the highest instances of human trafficking in the Western Hemisphere. Factors contributing to human trafficking in Colombia, such as internal violence and displacement, drug trafficking, a weak central government, and widespread corruption, have overpowered what energies the government marshaled against it. Moreover, governmental anti-trafficking programs tend to be underfunded, poorly administered, and quickly abandoned by Colombian officials. Additionally, hardline U.S. anti-drug policies in the region have aggravated the human trafficking problem without significantly affecting the flow of illegal drugs into the United States. Consequently, thwarting human trafficking, protecting and providing for its victims, and prosecuting perpetrators of the crime have been significantly challenging in this South American country.

Keywords: Colombia, human trafficking, drug trafficking, U.S. foreign policy, anti-drug policy, TVPA, trafficking in persons, anti-trafficking programs

CHINA’S ECONOMIC DEVELOPMENT PLAN IN XINJIANG
AND HOW IT AFFECTS ETHNIC INSTABILITY

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Advisor: Tristan Mabry, Department of National Security Affairs
Second Reader: Robert Looney, Department of National Security Affairs

To decrease ethnic instability in Xinjiang, the Chinese government’s plan is to economically develop the region. Xinjiang is rich in natural resources, is geographically significant and has a special economic zone. China is also investing in Central Asia to further meet its energy demand. A network of pipelines and major rail systems connect sources from China to Central Asia and beyond. Xinjiang’s economy will benefit from the network because it is the gateway and corridor to Central Asia and a hub for the Silk Road traffic. This study suggests that Xinjiang’s economic development led to a few destabilizing elements, including Han migration, income disparity and employment discrimination. All of this is taking place while the government is also dealing with other cultural issues, such as religion and education. The author hypothesizes that China’s economic development plan in the Xinjiang Uyghur (or Uighur) Autonomous Region increases, decreases or is a subsidiary factor to ethnic instability. This paper argues that China’s economic development plan for Xinjiang affects ethnic stability in Xinjiang as a subsidiary factor.

Keywords: China, Xinjiang, Central Asia, Uyghurs, Turkic, Hans, Silk Road, Western Development, economic, disparity, discrimination, special economic zone, infrastructure, natural resources, religion, Islam, ethnic, conflict, violence, riot, instability, migration
DETERRING WAR OR COURTING DISASTER: AN ANALYSIS OF NUCLEAR WEAPONS IN THE INDIAN OCEAN
Diana Wueger—Civilian, Department of the Navy
Master of Arts in Security Studies (Strategic Studies), 2015
Advisor: Paul Kapur, Department of National Security Affairs
Second Reader: Christopher Twomey, Department of National Security Affairs

One of the core assumptions of nuclear strategy is that submarine-based deterrent assets stabilize deterrent relationships by providing an assured second-strike capability. As India progresses toward an operational sea-based deterrent, this thesis seeks to qualify this foundational assumption by exploring the empirical conditions under which this principle operated during the Cold War. It then examines whether these conditions—and by extension the standard logic regarding sea-based deterrence—apply in South Asia. Using the India-China and India-Pakistan dyads as discrete cases, this thesis analyzes the potential effects of India’s introduction of a ballistic missile submarine (SSBN) on each dyad. While an operational sea-based deterrent should hypothetically provide India with a greater sense of existential security vis-à-vis China, there is little evidence to suggest that India will cease to pursue additional nuclear or conventional capabilities. India’s SSBN thus fails to resolve perceived security threats from China, even as it exacerbates arms racing tendencies in Pakistan. Furthermore, it is likely to generate conventional maritime arms races in both dyads that could prove destabilizing in a crisis. This thesis finds that assumptions based on Cold War-era analyses do not accommodate the geographic, bureaucratic, operational, or strategic realities of South Asia. Thus, this thesis concludes that traditional assumptions about SSBNs fail to acknowledge the conditionality of their strategic value while overlooking the potential dangers posed by the introduction of these systems.

Keywords: India, Pakistan, People’s Republic of China, Indian Ocean Region, strategic stability, regional stability, nuclear deterrence, arms race stability, crisis stability, SSBN, incidents at sea, SLBM, Arihant, Cold War, nuclear triad, ASW

PRIVACY IN THE FACE OF SURVEILLANCE: FOURTH AMENDMENT CONSIDERATIONS FOR FACIAL RECOGNITION TECHNOLOGY
Eric Wynn—Lieutenant, United States Navy
Master of Arts in Security Studies (Homeland Security and Defense), 2015
Advisor: Carolyn Halladay, Center for Civil-Military Relations
Second Reader: Erik Dahl, Department of National Security Affairs

Facial recognition technology adds a new dimension to government and police surveillance. If these organizations were to employ active surveillance using facial recognition technology, the implication could mean that people appearing in public places no longer have an expectation of privacy in anonymity. Real-time identification using facial recognition surveillance technology is not currently ready for successful employment by law enforcement or government agencies, but the speed with which the technology is being developed means that a constitutional challenge to this new technology will serve as a turning point for the future of Fourth Amendment privacy jurisprudence and shape the future of surveillance in the digital age. This research explores the history and current state of facial recognition technology and examines the impacts of surveillance on privacy expectations. This thesis also reviews existing Fourth Amendment legal protections of privacy through a review of cases relating to government surveillance and privacy. The research effort finds that while facial recognition surveillance does not expressly violate current privacy protections, the courts have historically matured with advancing technology, and future court decisions are likely to decide soon whether the Fourth Amendment leans more toward safeguarding privacy or security when it comes to facial recognition surveillance.

Keywords: privacy, Fourth Amendment, surveillance, anonymity, facial recognition, technology, FRT, police, law enforcement, security, cameras, video, Next Generation Identification, NGI, Biometric Optical Surveillance System, BOSS, Federal Bureau of Investigation
The Naval Postgraduate School is required to report activity costs and set tuition rates annually. The requirement to adequately identify and charge appropriate tuition rates for Naval Postgraduate School programs is critical for complete cost recovery. This thesis reviews the Naval Postgraduate School product lines and applies Activity-Based Costing Theory to provide management with a standard to gauge program and price growth. All Naval Postgraduate School costs are assigned into service and production department costs. Service department costs (indirect and overhead) are accumulated individually and allocated to the Naval Postgraduate School product lines based on cost drivers. The Naval Postgraduate School student load and product line totals are used to reach an average cost per student year.

Keywords: Activity-based costing, ABC, direct allocation
MASTER OF SCIENCE

Applied Cyber Operations
Applied Physics
Astronautical Engineering
Computer Science
Cyber Systems and Operations
Defense Analysis
Electrical Engineering
Information Technology Management
Management
Mechanical Engineering
Meteorology and Physical Oceanography
Network Operations and Technology
Operations Research
Physical Oceanography
Physics
Space Systems Operations
Systems Engineering
Insider threat is one of the risks both government and private organizations have to deal with in protecting their important information. Data exfiltration and data leakage resulting from insiders’ activities can be very difficult to identify and quantify. Unfortunately, existing solutions that efficiently check whether data moving across a network is known to be sensitive are not resilient to attackers that make changes—even trivial modifications—to the data prior to exfiltration. This capstone examines the potential use of the sdhash approximate matching algorithm within the data exfiltration domain. Sdhash can be employed to look for active transfer of known sensitive files in network traffic, but in practice is hindered by the computational time required to check for known sensitive data. This research tested the performance of both the GPU and CPU implementation of sdhash to determine their suitability in high-network traffic environments such as the Department of Defense. The results of this experiment showed that better performance is achieved with the GPU when comparing large data sets. For small data sets, the CPU and GPU implementations exhibited similar performance. Thus, sdhash in the GPU implementation would be suitable for the Defense Department’s use.

Keywords: Data exfiltration, data leakage, insider threat, approximate matching, sdhash, GPU, CPU, similarity digest, and network capture.
CHARACTERIZATION OF HEAVY OXIDE INORGANIC SCINTILLATOR CRYSTALS FOR DIRECT DETECTION OF FAST NEUTRONS BASED ON INELASTIC SCATTERING

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Master of Science in Applied Physics, 2015
Advisor: Craig Smith, Department of Physics
Co-Advisor: Gamani Karunasiri, Department of Physics

Heavy oxide inorganic scintillators may prove viable in the detection of fast neutrons based on the mechanism of inelastic neutron scattering. A candidate set of crystals incorporating constituents of heavy atomic mass, namely bismuth germinate (BGO), zinc tungstate (ZWO), cadmium tungstate (CWO), lead tungstate (PWO), lutetium-gadolinium orthosilicate activated with cerium (LGSO:Ce) and lutetium-aluminum garnet with cerium (LuAG:Ce), were characterized to reveal relevant properties for efficient fast neutron detection. The optical measurements indicated strong transmittance with minimal absorption occurring in the visible spectrum. On average, the crystals achieved approximately 80% transmittance and 3% absorption, with the remaining light reflected at the air/crystal interface. Cathodoluminescence (CL) measurements with electron excitation energy of 5 keV provided information on the peak wavelength emission and light intensity. Results show that BGO and LGSO:Ce produced the highest scintillation light output and sharpest peak formation. Uncertain Ce3+ concentration and the presence of Eu3+ admixture caused LuAG:Ce to red shift and produce a false-positive bright emission. The gamma induced scintillation measurement yielded preliminary results showing stratification in light output based on incident energy in the range of 0.081–1.275 MeV. CWO and LGSO:Ce, crystals with similar structure, appeared less susceptible to this phenomenon.

Keywords: inelastic scattering, cathodoluminescence, heavy oxide inorganic scintillators, direct detection fast neutrons, gamma induced scintillation, scintillator crystals
MASTER OF SCIENCE
IN
ASTRONAUTICAL ENGINEERING

PROTOTYPING AND CHARACTERIZATION OF AN ADJUSTABLE SKEW ANGLE SINGLE GIMBAL CONTROL MOMENT GYROSCOPE
Shawn Kocis–Lieutenant Commander, United States Navy
Master of Science in Astronautical Engineering, 2015
Advisor: Mark Karpenko, Department of Mechanical and Aerospace Engineering
Second Reader: I. Michael Ross, Mechanical and Aerospace Engineering

This thesis is the second phase of development of an open architecture control moment gyroscope (CMG). The focus is on designing an adjustable skew angle single gimbal CMG frame, and integrating a previously developed momentum wheel assembly into it. The result of this phase is a fully operational CMG that can be used to retrofit the NPS Reconfigurable Satellite Autonomy Testbed (R-SAT). The open architecture design allows for both hardware and software upgrades to the R-SAT Attitude Determination and Control System (ADCS). This capability is vitally important in order to support the development and testing of new satellite control algorithms that can be used to improve the agility and efficiency of satellite maneuvers. The CMG developed in this project is capable of delivering 7.79 Nm of output torque at the standard gimbal rate of 1 rad/s. The CMG power consumption ranges between 50W and 100W.

Keywords: Control Moment Gyroscope, Control Moment Gyro, gimbal, momentum, wheel, momentum wheel assembly, skew angle, adjustable skew angle, back drive, open architecture

ANALYSIS OF SCIENCE ATTITUDES FOR K2 PLANET HUNTER MISSION
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Master of Science in Astronautical Engineering and Master of Science in Physics, 2015
Advisor: Mark Karpenko, Department of Mechanical and Aerospace Engineering
Co-Advisor: James Luscombe, Department of Physics
Second Reader: I. Michael Ross, Department of Mechanical and Aerospace Engineering

NASA designed the Kepler spacecraft to detect extrasolar planets, but after several successful years, with many new discoveries, two out of four reaction wheels failed. NASA repurposed Kepler to continue science under the new mission, K2. The physics of how Kepler detects planets, the transit method, is first described. As part of this description it is shown that pointing noise is the limiting factor of Kepler’s ability to detect planets. The second part of this thesis uses a flat plate solar torque model of Kepler in order to assess the capabilities of the spacecraft in other off ecliptic attitudes. This analysis concluded that the controllability of the failed spacecraft in the presence of the solar torque is the main driver for the new K2 mission attitude and that conducting science out of ecliptic plane attitudes present challenges from the control point of view.

Keywords: Kepler, solar torque, spacecraft, photometric precision, planet detection, K2, flat plate Kepler model, solar radiation pressure, star classification, transit method, planet definition
Society’s pervasive use of mobile technologies has provided an incentive for the amount and kinds of mobile malware to steadily increase since 2004. Challenges in static analysis of mobile malware have stimulated the need for emulated, dynamic analysis techniques. Unfortunately, emulating mobile devices is nontrivial because of the different types of hardware features onboard (e.g., sensors) and the manner in which users interact with their devices as compared to traditional computing platforms. To test this, our research focuses on the enumeration and comparison of static attributes and event values from sensors and dynamic resources on Android runtime environments, both from physical devices and online analysis services. Utilizing our results from enumeration, we develop two different Android applications that are successful in detecting and evading the emulated environments utilized by those mobile analysis services during execution. When ran on physical devices, the same applications successfully perform a pseudo-malware action and send device identifying information to our server for logging.

Keywords: Mobile, malware, smartphone, cellular, Android, malware analysis, dynamic analysis, sensor, emulated environment

IP INFRASTRUCTURE GEOLOCATION
This paper has been recognized as an outstanding thesis by its department.

This paper has been recognized as an outstanding thesis by its department.

Guan Yan Cai–Civilian, Ministry of Defense, Singapore
Master of Science in Computer Science, 2015
Advisor: Robert Beverly, Department of Computer Science
Second Reader: Geoffrey Xie, Department of Computer Science

Physical network maps are important to critical infrastructure defense and planning. Current state-of-the-art network infrastructure geolocation relies on Domain Name System (DNS) inferences. However, not only is using the DNS relatively inaccurate for infrastructure geolocation, many router interfaces lack DNS name entries. We adapt the technique of Wang et al. to send trace route probes from distributed vantage points, and approximate a target’s location by finding the nearest landmark. To evaluate the technique’s performance, we geolocate router interfaces previously geolocated via DNS-based router positioning (DRoP). Our results show that 50% of the targets have error distances greater than 2,400 km; however, 75% of the nearest landmark predictions are less than 5 ms distant. We find that geolocation accuracy is insensitive to vantage point location, while the use of more vantage points improves accuracy. To better understand these results, we use Constraint-based Geolocation (CBG) on a subset of DRoP predictions. Forty-six percent of 4,638 DRoP location inferences are in regions outside the feasible physical boundaries imposed by CBG and 56% are 1,800 km
away from the CBG centroid. Our findings suggest that our methodology can supplement prior work to not only geolocate infrastructure without DNS names, but also improve accuracy.

Keywords: Internet, IP geolocation, IP infrastructure, routers, Domain Name System

**NAVIGATIONAL HEADS-UP DISPLAY: WILL A SHIPBOARD AUGMENTED ELECTRONIC NAVIGATION SYSTEM SINK OR SWIM?**

This paper has been recognized as an outstanding thesis by its department.

Brendan Geoghegan—Lieutenant, United States Navy
Master of Science in Computer Science, 2015
Advisor: Amelia Sadagic, MOVES Institute
Co-Advisor: Perry McDowell, MOVES Institute

The aim of this thesis is to develop and test a proof-of-concept augmented reality display that presents critical navigation information to naval conning officers. The objective of this research effort was to study the feasibility and usability of such an approach in operational conditions. The testbed platform consisted of a virtual environment that fully simulated a conning officer’s basic tasks in conditions of restricted navigation; this type of setup enabled a cost-effective test solution that was safe and supported scenario repeatability in studies with human subjects. The study involved 25 experienced test subjects who were surface warfare officers at both the Naval Postgraduate School and Surface Warfare Officer School. This effort helped acquire a comprehensive set of objective and subjective data that provided a close insight into the performance of conning officers. The empirical results demonstrate the viability of using such a system in an operation environment and support a need for further research and development of a working display platform onboard Navy warships

Keywords: Conning, virtual reality, augmented reality, cognitive tunneling, ship navigation, user study, heads-up display, performance evaluation, simulation

**IMPROVING SECTOR HASH CARVING WITH RULE-BASED AND ENTROPY-BASED NON-PROBATIVE BLOCK FILTERS**

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Master of Science in Computer Science, 2015
Advisor: Michael McCarrin, Department of Computer Science
Co-Advisor: Joel Young, Department of Computer Science

Digital forensic investigators have traditionally used file hashes to identify known content on searched media. Recently, sector hashing has been proposed as an alternative identification method, in which files are broken up into blocks, which are then compared to sectors on searched media. Since sectors are read sequentially without accessing the file system, sector hashing can be parallelized easily and is faster than traditional methods. In addition, sector hashing can identify partial files, and does not require an exact file match. In some cases, the presence of even a single block is sufficient to demonstrate with high probability that a file resides on a drive. However, non-probative blocks, common across many files, generate false positive matches; a problem that must be addressed before sector hashing can be adopted. We conduct 7 experiments in two phases to filter non-probative blocks. Our first phase uses rule-based and entropy-based non-probative block filters to improve matching against all file types. In the second phase, we restrict the problem to JPEG files. We find that for general hash-based carving, a rule-based approach outperforms a simple entropy threshold. When searching for JPEGs, we find that an entropy threshold of 10.9 gives a precision of 80% and an accuracy of 99%.

Keywords: digital forensics, digital fingerprinting, approximate matching, sector hashing, distinct blocks, probative blocks, block filtering, hash databases, hash carving
Recently, marine services company Phoenix International headed the search efforts for Malaysian Airlines flight 370 using its Bluefin-21 autonomous unmanned underwater vehicle (UUV). In total, it conducted 270 hours of in-water time and covered approximately 250 square miles of ocean floor. Deploying multiple UUVs simultaneously would have increased the coverage area substantially within the same time period. Ideally, a coalition of countries would be able to jointly deploy their autonomous UUVs with little or no advance preparation since search time is limited. Such a task is beyond today’s capabilities. Multiple UUV coordination today relies heavily on acoustic communications, advance preparation and manual guidance. This thesis explores the application of static analysis to allow multiple UUVs to be deployed simultaneously with little advance preparation and no acoustic communications.

Keywords: UUV, AUV, acoustic communications, finite-state machine, Moore automata, dead-reckoning, static plan, runtime plan, rapid deployment, GPS

Aircraft carriers are the centerpiece of the United States Navy. The primary weapon system of the aircraft carrier is the attached airwing and the combat power provided by its various aircraft. The airwing is only effective while airborne and thus dependent on the skill and training of a small number of launch officers known as shooters. Shooter training is accomplished on-the-job and often requires the launch officers to go underway on different aircraft carriers, at the expense of their parent command, in order to complete their qualifications. This thesis addresses the lack of alternative environments available for shooters to hone their skills. The results of a job task analysis provide insight into the skills required to perform the duties of a launch officer. Analysis of the data gathered from the job task analysis produced a flowchart that can be represented as a finite state machine and then reproduced in a virtual environment. A virtual environment was then created utilizing current virtual reality hardware and software to faithfully re-create an environment that presented the required attributes and scenarios to accomplish the tasks of a launch officer. This thesis yields a low-cost, portable, and safe alternative environment for shooters to perform the skills required for their training.

Keywords: virtual reality, catapult launch officer, flight deck, training in virtual environments, transfer of training

During a large-scale disaster, first responders face a number of different challenges. Their ability to communicate with each another is among the most critical challenges they face. If the disaster has wiped out the infrastructure that enables communications, it creates a serious issue for first responders. In such situations, infra-
structure-less technology could enable first responders to establish a communications network independent of any existing operational or non-operational infrastructure. Wi-Fi Direct can enable such communication, but it is fraught with issues that need to be addressed to make it usable for first responders. An extension to Wi-Fi Direct has been developed that would address these issues. The extended Wi-Fi Direct protocol allows for a persistent communications network that involves zero user interaction. The extensions to the protocol do not require any infrastructure or any human involvement to establish a communications network.

Keywords: wi-fi direct, wireless, peer to peer, persistent wireless

A SURVEY OF REAL-TIME OPERATING SYSTEMS AND VIRTUALIZATION SOLUTIONS FOR SPACE SYSTEMS
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Master of Science in Computer Science, 2015
Advisor: Thuy Nguyen, Department of Computer Science
Co-Advisor: Mark Gondree, Department of Computer Science

The Department of Defense and the intelligence community rely on space systems for a broad spectrum of services. These systems operate in highly constrained environments (in terms of space, weight and power), making virtualization and resource sharing a desirable approach. Agencies are actively exploring new architectures, such as those employing virtualization, to support their growing space mission. In this thesis, we review how virtualization architectures claim to support the real-time requirements of their guests. We survey real-time systems and virtualization architectures proposed for use in space systems. Further, we investigate the behaviors of virtualized operating systems using a method of remote network-based fingerprinting with TCP timestamps. Our work provides insights into how guests, both general purpose and real-time, behave in virtualized environments. Our survey work and experimental analysis aim to further understanding of how virtualization can be securely incorporated into space systems.

Keywords: virtualization, hypervisor, real-time operating system, fingerprinting, space system

TOWARD A ROBUST METHOD OF PRESENTING A RICH, INTERCONNECTED DECEPTIVE NETWORK TOPOLOGY
This paper has been recognized as an outstanding thesis by its department.
Austin West–Civilian, Department of Defense
Master of Science in Computer Science, 2015
Advisor: Robert Beverly, Department of Computer Science
Second Reader: Geoffrey Xie, Department of Computer Science

Every day, adversaries bombard Department of Defense computer networks with scanning traffic in order to gather information about the target network. This reconnaissance is typically a precursor to attacks designed to access data, exfiltrate information, or plant malware in order to gain a military advantage. One specific reconnaissance tool, traceroute, is used to map the network topology of a target network. We implement an active network defense tool, dubbed DeTracer, that seeks to thwart network mapping attacks through the use of deception. We deploy DeTracer in several environments, including the Internet, to demonstrate that an attacker attempting to map a target network using traceroute probes can be presented with a false network topology of the defender’s choosing. Our experiments show that a defender can present an adversary with a credible false network topology. We are able to deceive all types of incoming traceroute probes, present a complex false network topology on a per source and destination basis, and deploy our deception scheme without disrupting service to the real production infrastructure on our network.

Keywords: topological deception, active defense, traceroute, network defense
Cyberspace has become an essential component of modern militaries. As this dependency grows, militaries who exploit this dependency may be able to hurt their adversaries within cyberspace to coerce them into a desirable action. This thesis will explore one particular use of cyber coercion, the use of cyber weapons to target supply chains, to study what methods may be best suited for cyber coercion. This thesis first looks at the possibilities for cyber coercion and the various factors that are important for an attack method to successfully coerce an adversary, including reusability, reversibility, and legality. It then proposes various cyber attacks that could be used in cyber coercion and reviews factors important in cyber coercion. Next, it takes these proposed methods and walks through three scenarios against fictional nation-states to analyze how these methods might perform in a cyber-coercion operation. Included are possible effects if these same attacks were used against the United States. Findings are then presented based on the scenarios.

Keywords: cyber coercion, cyber warfare, cyber policy
There is a lack of attention to the aftermath of a deployed cyber weapon: There is no mechanism for the assignment of accountability for the restoration of affected infrastructure and remediation of violation of established laws of war after cyberattacks occur. This study analyzes International Humanitarian Law and international treaties as they apply to the cyber post-conflict period and explores current jus post bellum frameworks, which can be used to design a cyber-warfare jus post bellum framework. It also analyzes analogies to traditional warfare in the damage assessment and aid provided during the recovery period of the 1998 Kosovo and the 2003 Iraq Wars. It also discusses the available international cyber organizations. As an example, the study analyzes responses to cyberattacks in a case study involving South Korea and North Korea. Additionally, this study examines the related issues of the effects of deploying a cyber-weapon, the ways to establish acceptable levels of attribution, the challenges of cyber-damage assessments, and the ability to contain and reverse cyberattacks. This thesis proposes a cyber-warfare jus post bellum framework, with emphasis on prevention and cyber weapons control, proposes cyberattack relief-effort actions, and offers a post-cyberattack cost checklist.

Keywords: cyber-warfare, cyberattack, jus post bellum, international humanitarian law, international treaties, damage assessment, international cyber organizations, attribution, North Korea

The problem with current international disaster relief is ineffective communication, coordination, cooperation, and collaboration (4C). Ineffective international 4C allows chaos and anarchy to significantly hinder disaster-relief efforts. After action reports (AARs) and disaster relief (DR) materials were examined to identify system-level issues during DR missions. These issues were examined to determine if DR exhibits characteristics of a wicked problem. The results of systems-thinking analysis show that anarchy, social complexity, and stress within the DR system have a negative impact on all components of the system. To improve the effectiveness of DR missions and help mission teams to present a unified front for DR, anarchy, social complexity, and stress must be reduced. This work proposes a communication strategy for DR missions that harnesses capabilities of information communication and technology (ICT) solutions, introduces a cloud-based hierarchical trust model, and outlines a common integration interface. The strategy encourages open and transparent 4C between DR mission teams and the international DR community. Properly implemented, this communication strategy...
strategy could reduce system-level anarchy and social complexity, resulting in reduced post-disaster damage, injuries, and loss of life.

Keywords: disaster relief, emergency response, information communications and technology, integration, interface, cloud, security, disaster response, communications strategy

**CYBER WAR: THE NEXT FRONTIER FOR NATO**

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Master of Science in Cyber Systems and Operations, 2015

Advisor: Dorothy Denning, Department of Defense Analysis

Second Reader: Wade Huntley, Department of National Security Affairs

Defining and understanding what constitutes a cyber-attack is a complicated matter, largely due to the fact that there has not yet been a large-scale cyber-attack upon any nation. With the help of Michael Schmitt’s Tallinn Manual, published in 2013 by Cambridge University Press, it is possible to gain an understanding, although no policy expectations, of what elements need to be met for a cyber-attack to warrant a NATO response. This study analyzes and explores the unique position that NATO operates in and the duty of NATO to protect its alliance members, and member states to protect each other. Topics discussed include how cyber-attacks are defined and identified, the particular challenges of NATO when addressing cyber-attacks, the severity of cyber-attacks, and what would need to occur in order for a victim-state to ask NATO to invoke Article 5. This thesis discusses the readiness of NATO to respond to a cyber-attack and what the conditions necessary for an Article 5 response, and what that response would potentially look like. Finally, this work provides recommendations for actions that NATO could take to both prevent and confront cyber attacks.

Keywords: NATO, Article 5, cyber-attack, Tallinn Manual

**SUPPORTING THE MARITIME INFORMATION DOMINANCE: OPTIMIZING TACTICAL NETWORK FOR BIOMETRIC DATA SHARING IN MARITIME INTERDICTION OPERATIONS**

Adam Sinsel–Lieutenant, United States Navy

Master of Science in Cyber Systems and Operations, 2015

Advisor: Alex Bordetsky, Department of Information Sciences

Second Reader: Albert Barreto, Department of Information Sciences

This research intends to improve information dominance in the maritime domain by optimizing tactical mobile ad hoc network (MANET) systems for wireless sharing of biometric data in maritime interdiction operations (MIO). Current methods for sharing biometric data in MIO are unnecessarily slow and do not leverage wireless networks at the tactical edge to maximize information dominance. Field experiments allow students to test wireless MANETs at the tactical edge. Analysis is focused on determining optimal MANET design and implementation. It considers various implementations with varied antenna selection, radio power, and frequency specifications, and two specific methods of integrating Department of Defense biometric collection devices to the wireless MANET, which utilizes a single (WR) MPU4 802.11 Wi-Fi access point to connect secure electronic enrollment kit II (SEEK II) biometric devices to the MANET, and tethers each SEEK device to a dedicated WR using a personal Ethernet connection. Biometric data is shared across the tactical network and transmitted to remote servers. Observations and analysis regarding network performance demonstrate that wireless MANETs can be optimized for biometric reach back and integrated with biometric devices to improve biometric data sharing in MIO.

Keywords: MIO, VBSS, MANET, wireless mesh
As the Department of Defense executes its mission in its newest warfare domain, cyberspace, some have questioned its choices with regard to command and control of its cyber forces. This thesis examines historical cases of new warfare domains and how the Department of Defense structured the command and control elements of its forces dedicated to the air and space domains. It explores the current cyber command and control construct, and looks at two others that would likely be employed if a change in command and control were to occur. Those examined include a new functional combatant command focused on cyber, similar to U.S. Special Operations Command, and a stand-alone U.S. Cyber Force. This thesis considers the benefits and drawbacks of each, and seeks to serve as an informative tool should policymakers determine a new command and control model is necessary for cyber forces.

Keywords: warfare domains, cyber, command and control, USCYBERCOM, combatant command, cyber force

The purpose of a bring-your-own-device (BYOD) program is to increase productivity as it allows individuals to access and manipulate data from non-traditional workplaces to support mission requirements. The United States Marine Corps (USMC) has started a pilot BYOD program, but a user policy for the USMC BYOD program has not yet been identified, despite the driving force that policy has on final implementation and potential acceptance. Therefore, this thesis answers the question, is it possible to develop a BYOD user policy for the USMC that minimizes risk for all parties while allowing for the intended flexibility? Three case studies were conducted on organizations that have implemented BYOD programs, comparing user policies and best practices to mitigate risks and address user privacy concerns. The case studies were also compared with governing Department of Defense instructions and National Institute of Standards and Technology guidance to identify a baseline of applicable security controls to formulate a viable user policy and agreement to support USMC security requirements. This thesis found that a clearly articulated user agreement tailored to the USMC's technological solution can be written to support the successful implementation of its BYOD program to ensure the benefits outweigh the potential risks.

Keywords: bring-your-own-device, BYOD, mobile device; personally owned mobile device, privacy, user policy, user agreement, United States Marine Corps, USMC, BYOD pilot program, BYOD case study, BYOD implementation, BYOD considerations, BYOD recommendations
Throughout its history, the United States has demonstrated an ability to effect regime change through the use of special warfare, particularly clandestine and covert operations. However, these regime changes have failed to yield favorable, enduring strategic results for the United States. One reason for this failure can be attributed to the difficulty formulating a strategic narrative designed to elicit domestic and international support. Drawing from the tenets of social movement theory, this thesis examines the cases of the Iran Coup of 1953, the Guatemalan Coup of 1954, and the Nicaragua Revolution of 1978–1990 to analyze the impacts of operations aimed at shaping the perceptions of foreign target audiences in support of special warfare objectives. Furthermore, this thesis offers recommendations regarding the requisite means and organizational forms required to create strategic narratives that support influence operations in cases of regime change and other special warfare operation.

Keywords: MISO, PSYOP, social movement theory, regime change, influence

With the U.S. aircraft carrier fleet facing reduced availability, this thesis explores the possibility of using the submarine force in an expanded role in naval diplomacy. This research suggests that submarines have the capability to communicate a signal to an opponent state by temporarily revealing themselves tactically. This signal of hidden capacity can be tailored into a tacit bargaining strategy that can significantly influence rival navies. By examining the development of naval diplomacy over the last two hundred years, this thesis critically reexamines U.S.-aircraft-carrier-based diplomatic practices relative to the emerging use of rival submarine forces in asymmetrical signaling strategies. In examining Russian, British, and Chinese attempts to signal adversaries using submarines, this thesis provides context for the capacity submarines have in today’s naval diplomatic setting to force large changes in opponents’ strategic frameworks at low cost to the initiators. Because of these findings, this thesis recommends increased evaluation of such activities from a diplomatic and strategic perspective and increased awareness that such signals may be aimed at our military.

Keywords: submarines, strategic signaling, strategic signals, signaling tool, naval diplomacy, United States, Soviet Union, Britain, Argentina, China, Russia, Japan, aircraft carrier, undersea warfare, asymmetrical advantage, tying hands, sinking costs, tacit revel
The Special Forces warrant officer is vital to the health of the Special Forces Regiment. The warrant officer’s institutional knowledge—developed over years of operational experience—is essential to the success of Special Operations Forces’ global endeavors. The Special Forces Regiment harnesses its future institutional capability through the recruitment and retention of Special Forces warrant officers. For the past five years, the Special Forces Regiment has seen a decrease in its warrant officer recruitment and retention rates. If left unattended, these rates will likely continue to decline. This thesis offers insights into the factors affecting the recruitment and retention of Special Forces warrant officers. By looking at recruitment and retention policies and assessing expert opinion in the Regiment, this thesis attempts to determine the recruitment and retention modifications that may reverse the declining trend. In doing so, this thesis identifies multiple factors affecting the recruitment and retention of Special Forces warrant officers and, specifically, focuses on two: (1) recruitment is drawn from a limited pool of eligible non-commissioned officers who face both the stigma of leaving the NCO ranks and pay disparities if they choose to transition; and (2) the lack of upward mobility through the senior warrant officer ranks.

Keywords: Special Forces warrant officer, United States Army Special Forces Command, regiment, recruitment, retention
Conventional separation techniques such as filters cannot be used in a scenario where a weak signal is embedded within a stronger signal in the same frequency band. An adaptive filter approach to recover a weak narrowband communication signal embedded in a strong wideband broadcast signal and additive noise is investigated by taking advantage of the known characteristics of the broadcast signal standard. The weak signal considered is a four-quadrature amplitude modulation (QAM) communication signal, and the stronger signal is a Digital Terrestrial Multimedia Broadcasting (DTMB) signal, which is the digital television standard for People's Republic of China. The results show that, while the extraction of the weak signal is possible, the characteristics of the transmission channel must be very accurately estimated for the scheme to achieve a reasonable error rate.

Keywords: adaptive filter, signal separation
Smart card transaction times will increase as the number of bits used in the algorithms protecting the cards to ensure security increases. This is a potential problem for the Department of Defense, which requires smart card usage for its employees. This paper defines, compares, and contrasts two algorithms: Rivest-Shamir-Adleman (RSA) and Elliptic Curve Cryptography (ECC), and then provides test data for encryption algorithms tested on particular certification key processes in an attempt to show that the ECC encryption algorithm provides the security necessary for smart card operations at a fast enough speed to benefit smart card users. It describes the Open Protocol for Access Control Identification and Ticketing with privacY (OPACITY) pilot project that took place over 2014 in relation to the card testing, and hypothesizes the risks and mitigation factors for the Department of Defense to permanently switch to the ECC algorithm for smart card use.

Keywords: smart cards, elliptic curve cryptography, mobile technology, encryption algorithms, certification key processes
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management

Analysis of Suicide Behaviors in the Navy Active Duty and Reserve Component Population

This paper has been recognized as an outstanding thesis by its department.

Neeta Blankenship—Lieutenant Commander, United States Navy
Kristin Shepherd—Lieutenant Commander, United States Navy
Master of Science in Management, 2015
Advisor: Yu-Chu Shen, Graduate School of Business and Public Policy
Co-Advisor: Jesse Cunha, Graduate School of Business and Public Policy

We analyze the role of service-specific and mental health risk factors in active duty and reserve component Navy enlisted and officer suicide attempts and deaths from 2002 to 2011. We estimate the effect of non-demographic, service-specific, pre-screening, and mental health factors through logit regression to determine their association with the occurrence of suicide attempts and death by suicide. We further evaluate how these risk factors differ between the active duty and reserve components. Results consistently found that diagnosed mental health conditions, specifically, depression and substance use, increased the odds of Sailors in all populations attempting and/or dying by suicide. Service-specific factors showed varying levels of significance across the different populations; however, those who were demoted and entry-level paygrades (E1-E4) in the enlisted population were at higher risk for suicide attempt and death. Deployment to a combat zone was associated with lower odds of attempting and dying by suicide for all populations except enlisted reservists. There were few significant covariates of suicide attempts or death among the officer population. The identification of common risk factors will aid in identifying service-wide efforts to determine the highest risk populations and develop tailored prevention programs.

Keywords: suicide, suicide attempt, risk factor, characteristic, demographic, service-specific, mental health, PTSD, substance use, depression, resiliency, readiness

Pre-accession Factors in the Performance and Retention of Hispanic Enlistees

This paper has been recognized as an outstanding thesis by its department.

Ryan Bowers—Lieutenant Junior Grade, United States Navy
Master of Science in Management, 2015
Advisor: Stephen Mehay, Graduate School of Business and Public Policy
Co-Advisor: Simona Tick, Graduate School of Business and Public Policy

This thesis applies quantitative methods to analyze the effect of pre-accession characteristics and early career experiences on the first-term attrition, retention, and fast-track promotion rates of Hispanic and non-Hispanic enlistees in the United States Navy. Using data from the Personalized Recruiting for Immediate and Delayed Enlistment system and the Defense Manpower Data Center for enlistees that joined the Navy in FY 2001–2009, followed during their careers until FY 2013 or separation, the multivariate analysis main findings show that Hispanics serving in the Navy appear to be well adjusted to military service. These sailors are serving critical roles around the world, and, based on attrition and retention metrics, perform somewhat better than their non-Hispanic counterparts. On the other hand, Hispanic sailors are promoting at somewhat slower rates
than their non-Hispanic peers. Based on the findings of this thesis, recommendations are formulated to support interventions that can make the U.S. Navy a stronger, more diverse organization.

Keywords: Navy, Hispanic, Delayed Entry Program, DEP, enlisted, pre-accession, first-term, attrition, recruiting, promotion, promotion rates, retention, career success, citizenship, quality of education, education tier, HSDG, NHSDG, English language

EFFECTIVENESS OF THE UNITED STATES MARINE CORPS TIERED EVALUATION SYSTEM
Lucas Crider—Captain, United States Marine Corps
Master of Science in Management, 2015
Advisor: Jeremy Arkes, Graduate School of Business and Public Policy
Co-Advisor: Chad Seagren, Department of Operations Research

This thesis analyzes how effective the Marine Corps Tiered Evaluation System is at measuring future success, more specifically, in the form of promotions, career longevity, physical fitness level and performance evaluation averages. The analysis observes first term re-enlistees from each quality tier through their future service to observe promotions, career longevity, physical fitness level and performance evaluation averages. The analysis utilizes ordinary least squares regression and linear probability models to analyze success measure outcomes. The outcomes are compared across various tier levels to determine if the tiered evaluation system is a valid tool at predicting future success. The findings indicate the Marine Corps Tiered Evaluation System is valid at distinguishing individual quality but can be improved in many ways to better distinguish quality and aid the decision makers in the reenlistment process. These improvements include a system encompassing more tiers and re-weighting the quality score components. The USMC Tiered Evaluation System is the foundation for identifying quality Marines for retention. Improving this system will better aid stakeholders in the reenlistment process and improve overall quality and organizational effectiveness.

Keywords: Tiered Evaluation System, First Term Alignment Program, quality, retention

FACTORS AFFECTING THE PERFORMANCE OF HISPANIC AND NON-HISPANIC MARINE CORPS ENLISTEES
Matthew Curry—Captain, United States Marine Corps
Master of Science in Management, 2015
Advisor: Simona Tick, Graduate School of Business and Public Policy
Co-Advisor: Stephen Mehay, Graduate School of Business and Public Policy

In its 2011 Final Report, the Military Leadership Diversity Council directed the Armed Forces to develop a demographically diverse leadership. Using multivariate probit and linear regression analysis, and a dataset of 204,000 non-prior service active duty enlisted accessions who entered service between 2003 and 2009, I examine the factors that explain differences in Hispanics’ and non-Hispanics’ performance outcomes such as first-term attrition, reenlistment and promotion, which ultimately affect senior enlisted leadership demographics. The findings show that Hispanics are more likely to complete their initial term of obligated service than non-Hispanics; however, the Hispanics effect disappears or becomes negative later in the career. In this thesis, I also propose and test a performance metric, called Success Score, derived from commander evaluations, physical fitness tests and rifle marksmanship scores. The findings of the statistical analysis suggest that the Success Score measure is the most significant factor in explaining differences in attrition, reenlistment and promotion among Hispanics and non-Hispanics. They also show that mathematical aptitude, as measured by the AR and MK ASVAB subtests, is as important as AFQT in predicting an enlistee’s Success Score. I recommend that the Marine Corps establish a trial group using AR, MK and AFQT scores to assess cognitive ability,
along with more stringent waiver and body composition requirements to improve the quality of the enlisted applicant pool.

Keywords: Hispanic, diversity, USMC, Marine Corps, enlisted, attrition, retention, promotion, performance, AFQT

SELECTION FOR CAREER COURSE AND IMPACT ON RETENTION OF BRAZILIAN AIR FORCE OFFICERS
Marcus Vinicius De Mello Takahashi–Lieutenant Colonel, Brazilian Air Force
Master of Science in Management, 2015
Advisor: Dina Shatnawi, Graduate School of Business and Public Policy
Co-Advisor: Marco DiRenzo, Graduate School of Business and Public Policy

This research examines the effect of a particular non-monetary incentive on the retention of active duty Brazilian Air Force colonels. The objective is to provide evidence to support the Brazilian Air Force Manpower decision makers in establishing policies regarding the selection of colonels for a career course. The characteristics of the incentives and the links to Expectancy Theory were reviewed to frame the hypotheses. Using two sources of data from the Brazilian Air Force manpower databanks, logit regressions and descriptive statistics were analyzed to check the validity of the hypothesis and found overall that the selection of colonel for a career course (defined in Brazilian law as prerequisite for promotion) is strongly correlated with retention probability. Furthermore, the interaction between the selection for the course and the information the military receives from the performance appraisal system plays a significant role in retirement decisions.

Keywords: Brazilian Air Force, Expectancy Theory, career course, incentives, retention

UTILIZATION OF GRADUATE EDUCATION IN THE UNITED STATES MARINE CORPS
Daniel Ealy–Captain, United States Marine Corps
Master of Science in Management, 2015
Advisor: William Hatch, Graduate School of Business and Public Policy
Co-Advisor: Simona Tick, Graduate School of Business and Public Policy
Second Reader: Mitchell McCarthy, Senior U.S. Marine Corps Liaison

This research was conducted at the request of Marine Corps University and examined the utilization of 344 graduate education billets within the Marine Corps. The research findings make two recommendations: 1) DC CD&I should charter a working group and use this research as a basis to review the reallocation of under-utilized BEEC BMOSs. 2) DC CD&I should also review BEEC BMOS structure and consider a new distribution plan that includes a new graduate education requirements assessment. These billets are highly desired by units due to their excepted manning precedence level. This thesis used survey methods to collect utilization data on Marine Corps Officers that graduated from the Special Education Program and the Advanced Degree Program between the years of 2009 and 2013. The survey is approved through the Naval Postgraduate School Institutional Review Board (NPS IRB), sponsored through Training and Education Command (TECOM) and supported by Headquarters Marine Corps (HQMC). The data collected from the survey was analyzed to identify significant factors that are highly correlated with low and high utilization in order to improve efficiencies. Findings include initial placement rate from school to billet of 93 percent and the utilization rate reflecting self-reported usage while in billet of 75 percent, identified throughout individual tours. This difference between placement utilization reflects the disparity between top-down and bottom-up planning. Collective review and reorganization of these billets is recommended to reduce further disparity between placement and
utilization rates. Objective evaluation and fair reorganization based upon high utilization will ensure Marine Corps human resource assets remain a constant force multiplier and act as a model for high retention strategy.

Keywords: utilization, United States Marine Corps, graduate education, multivariate regression, survey, special education program, advanced degree program, advanced graduate education program, probit regression, and master’s degree.

GENDER DIFFERENCES IN LIFE-WORK BALANCE AND THEIR IMPACT ON FEMALE OCCUPATIONAL CHOICE AND RETENTION
Kirk Emanuelsen–Lieutenant Commander, United States Navy
Jon Lee–Lieutenant Commander, United States Navy
Master of Science in Management, 2015
Advisor: Dina Shatnawi, Graduate School of Business and Public Policy
Co-Advisor: Marco DiRenzo, Graduate School of Business and Public Policy

This study explores gender differences in defining, interpreting and achieving life-work balance and the factors influencing occupational choice among naval officers. Since Navy-wide data is not available, and it was not possible for us to conduct interviews and administer a large-scale survey during the study timeframe, we led a smaller study using a sample of naval officers from the Naval Postgraduate School (NPS). In particular, 15 semi-structured interviews and 197 observations from an online survey administered to NPS students, all with a wide range of experiences and subspecialties, were collected. The data was analyzed using qualitative methods and common themes were identified. Findings suggest that men and women have similar definitions of life-work balance and identified similar factors that influence their occupational choice; however, women value more factors when making those decisions. While this study provides initial insight into factors that influence retention, gender differences in the scope and impact are worthy of further exploration.

Keywords: female, manpower, accession, retention, life-work balance, occupational choice

DEVELOPING A MODEL FOR ASSIGNING SENIOR OFFICERS IN THE BRAZILIAN AIR FORCE
Arthur Gentil Toneli–Lieutenant Colonel, Brazilian Air Force
Master of Science in Management, 2015
Advisor: Chad Seagren, Department of Operations Research
Second Reader: Benjamin Roberts, Graduate School of Business and Public Policy

The Brazilian Air Force faces a huge challenge in the assignment process. While aviators outnumber any other community, there are few jobs related to aviation available for senior officers. As a consequence, when junior aviators who invested their time improving their skills in air operations are promoted to senior ranks, they must be assigned to managerial positions in areas they don’t master. The problem becomes worse in the absence of career paths for senior officers and at the discretion of officers and commands to present their preferences in the assignment process with no regard for previous job experience. The purpose of this thesis is to develop a model for assigning senior officers without specialization, as it occurs among aviators in the Brazilian Air Force, so that job performance can be maximized. The model uses linear programming and takes individual preferences and organizational needs into consideration. The results of simulation in three different scenarios suggest that it is possible to capitalize on previous job experience and simultaneously satisfy the interests of officers and commands. One expected benefit of the study is the natural specialization of senior officers, without the intervention of career managers.

Keywords: assignment process, senior officer, linear programming, job performance, job experience, individual preference
DETERMINING HOW TO BEST PREDICT NAVY RECRUITING USING VARIOUS ECONOMIC VARIABLES
Timothy Henderson–Lieutenant, United States Navy
Master of Science in Management, 2015
Advisor: Jeremy Arkes, Graduate School of Business and Public Policy
Co-Advisor: Dina Shatnawi, Graduate School of Business and Public Policy

The objective of this study is to examine the effect that state-level and county-level economic variables have on U.S. Navy recruiting. To achieve this goal, I conducted state-level and county-level fixed effects models that examined the effects of state and county unemployment rates, as well as state employment-to-population ratios on Navy recruiting applicant rates, accession rates, high-quality applicant rates, and high-quality accession rates over the years from 1991 to 2013. Through the state-level and county-level fixed effects model estimation, it is determined that state unemployment rates, state employment-to-population ratios, and county unemployment rates all have a statistically significant effect on Navy recruiting, and that they all predict Navy recruiting equally well.

Keywords: manpower/supply, personnel, requirements/determination, economy

MARINE CORPS BUDGETARY REPROGRAMMING EFFECTIVENESS
Mark Kugler Jr.–Captain, United States Marine Corps
Master of Science in Management, 2015
Advisor: Robert Eger III, Graduate School of Business and Public Policy
Second Reader: Philip Candreva, Graduate School of Business and Public Policy

Within the Department of Defense, funds are appropriated and budget authority is issued; resources are then executed accordingly. However, higher priority adjustments occur due to unintended and looming threats and needs. The abilities granted through the use of reprogramming allow for the shifting of funds within and among programs. Thus, service effectiveness in the execution of funding can be enhanced or reduced by the latitude granted to the defense department in its ability to reprogram funds. Several methods of analysis, such as the measures of central tendency and the measures of dispersion, are applied supportive of reprogramming effectiveness. Through these methods this thesis tests the Marine Corps’ effectiveness in its role of budgetary execution through the use of reprogramming activities for a 10-year period from 2005 to 2014. In order to properly compare and contrast reprogramming actions, data encompassing the entire DOD was gathered. Results show that Marine Corps reprogramming, much like the DOD, is on a downward trend although displaying varying results across major defense appropriations and between the services. Effectiveness traces the same line and remains relative to the overall decline of the budget authority.

Keywords: reprogramming, transfers, PPBE, defense budgeting, execution

DECEPTION DETECTION PROCESS AND ACCURACY: AN EXAMINATION OF HOW INTERNATIONAL MILITARY OFFICERS DETECT DECEPTION IN THE WORKPLACE
This paper has been recognized as an outstanding thesis by its department.
Boris Kun–Ensign, United States Navy
Will Whaley–Major, United States Marine Corps
Master of Science in Management, 2015
Advisor: Lisa Lindsey, Graduate School of Business and Public Policy
Second Reader: Benjamin Roberts, Graduate School of Business and Public Policy

This thesis replicates recent diagnostic utility studies to determine whether the original methods are (1) generalizable to a new population and (2) useful in identifying specific questioning strategies relevant to interna-
tional militaries. Previous research shows that people are, on average, only slightly better-than-chance at detecting deception. In 2006, *Personality and Social Psychology Review* published *Accuracy of Deception Judgments* in which Charles F. Bond Jr. and Bella DePaulo identified that meta-analysis yields an across-study average accuracy rate of about 54%. New research has shifted from the historical cue-based deception detection paradigm in favor of the idea of diagnostic utility. Specifically, this new line of research provides a basis for demonstrating that the design of specific questions is vital in determining deceptive individuals. Currently, the research conducted thus far provides levels of deception detection accuracy significantly greater than the usual slightly-better-than-chance results that is characterized by historical research. Our findings from quantitative Study 1 demonstrated that international military officer participants detected deception at 70.8% for experts and 63.8% for non-experts. Finally, the authors’ qualitative Study 2 identified that participant’s claim to have utilized third-party information, physical information, and verbal/nonverbal clues most often when detecting deception in previous situations. These findings are in line with historical research.

Keywords: deception detection, fraud, diagnostic utility, questioning method, international officers, officers, workplace deception, fraudulent enlistment, recruiting, training, executive development, cost reduction solutions

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**AN ANALYSIS OF THE MARINE CORPS INDIVIDUAL READY RESERVE SCREENING PROCESS**

Sean Norton—Captain, United States Marine Corps

Master of Science in Management, 2015

Advisor: William Hatch, Graduate School of Business and Public Policy
Co-Advisor: Chad Seagren, Department of Operations Research

This research was conducted at the request of Marine Force Reserve (MARFORRES) G-1 and in liaison with Marine Corps Individual Reserve Support Activity (MCIRSA) to examine the current readiness processes of the Individual Ready Reserves (IRR). A qualitative and monetary analysis of the IRR’s readiness screening process for current and future IRR requirements was conducted to see whether it anticipates Manpower and Reserve Affair’s (M&RA) forecasts. This was done with the assistance of M&RA, MARFORRES, and MCIRSA, to improve the IRR screening process by capturing the actual number of qualified personnel for a contingency operation. The geographic nature of IRR Marines as they transition to civilian life affects their ability to participate making the screening of all IRR personnel extremely difficult. IRR Marines choose their post active-duty locations based on where they want to live, not on the requirements of a particular reserve unit or military installation. This constraint offers purpose to improve the 60 percent show rate at the musters and overall 80 percent participation rate. The research recommends MARFORRES establishes a more detailed tier-system to identify qualified Marines versus the unqualified, move toward an electronic mustering option with skills training and enforce participation through separation procedures for those neglecting their duties.

Keywords: Individual Ready Reserve, Marine Corps Individual Reserve Support Activity, Marine Forces Reserve, screening process

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**AN ANALYSIS OF PROMOTION AND RETENTION FACTORS AMONG HISPANIC AND NON-HISPANIC MARINE CORPS OFFICERS**

Mateo Salas—Major, United States Marine Corps

Master of Science in Management, 2015

Advisor: Simona Tick, Graduate School of Business and Public Policy
Co-Advisor: Stephen Mehay, Graduate School of Business and Public Policy

Hispanics are the fastest-growing demographic group in the U.S. This thesis reviews Marine Corps policies on the recruitment, retention, and promotion of talented officers of a diverse background, and applies quan-
titative multivariate analysis methods to identify pre-commissioning and post-commissioning factors, such as college performance, accession source, military training and fitness report scores that explain any differences in job performance measures of Marine Corps officers of different ethnic backgrounds. Using data on 7,780 Marine Corps officers commissioned from 1999 to 2004, the findings from multivariate regression analysis show that Hispanic Marine Corps officers have a greater likelihood of retention but no difference in fitness report performance and no difference in the probability of promotion to O4 in comparison to non-Hispanic officers.

Keywords: USMC, Hispanics, promotion, retention

THE EARNINGS OF VETERANS: EFFECTS OF MILITARY SERVICE
Russell Sansone–Lieutenant Commander, United States Navy
Master of Science in Management, 2015
Advisor: Marigee Bacolod, Graduate School of Business and Public Policy
Co-Advisor: Simona Tick, Graduate School of Business and Public Policy

This thesis examines the effects of military service on veterans’ earnings in the civilian labor force. This is important as the services allocate large amounts of resources to not only ensure readiness for the next mission, but to understand its return on investment and how to recruit and retain the force. Using data from Integrated Public Use Microdata Series 2000–2012 and multivariate analysis, this thesis identifies premiums and penalties in the civilian labor market associated with active service during conscription and the All-Volunteer Force. The analysis controls for educational attainment, occupation, race, periods of service, and active service years, and finds a penalty for veterans who have a post high school education, who, on average, have earnings that are lower than their observationally similar non-veteran counterparts. In addition, veterans in business and finance are observed to have a penalty for military service, compared to veterans in other occupations who are observed to earn more than non-veteran counterparts. Overall, this thesis finds a premium associated with service, as measured by post-service civilian earnings. The benefit of service varies across occupations, educational attainment and other factors.

Keywords: veteran earnings, veteran wages, veteran data, veteran regression model

DETERMINANTS OF FIRST-TERM ATTRITION FOR ENLISTED AND OFFICER SELECTED MARINE CORPS RESERVISTS
Ugur Ugurbas–Captain, Turkish Army
Mustafa Korkmaz–1st Lt, Turkish Gendarmerie General Command
Master of Science in Management, 2015
Advisor: Chad Seagren, Department of Operations Research
Co-Advisor: William Hatch, Graduate School of Business and Public Policy
Second Reader: Latika Hartmann, Graduate School of Business and Public Policy

This study examines the factors that correlate with first-term attrition of enlisted Marines and officers in the Selected Marine Corps Reserve (SMCR). The data for this study were provided by Headquarters Marine CorpsManpower and Reserve Affairs for fiscal years 2001 through 2014. We create two separate multivariate models to identify the causes of attrition for both populations. The enlisted personnel model used finds that rank and education have the greatest effect on the attrition behavior of enlisted Marines, while the Armed Forces Qualification Test scores and waiver have the least effect. For officers, rank has the greatest effect on the attrition probability, while age and unit type variables have the least effects. Numerous other variables under different categories were found to have significant effects on Marine SMCR attrition behavior. Some variables have different effects on each population, such as marital status. This variable is associated with higher
attrition rates for enlisted personnel, while it decreases the attrition probability of officers. Other variables in this category include Physical Fitness Test scores, unit type, and number of dependents.

Keywords: attrition, SMCR, officers, enlisted personnel, first-term, demographics

EVALUATION OF AVIATION CAREER PAY INCENTIVES AMONG THE NAVAL AVIATION ENTERPRISE UTILIZING AUCTION MECHANISMS
Brett Williams–Lieutenant Commander, United States Navy
Master of Science in Management, 2015
Advisor: Noah Myung, Graduate School of Business and Public Policy
Second Reader: William Gates, Graduate School of Business and Public Policy

Naval Aviation utilizes the Aviation Career Continuation Pay (ACCP) as a means to retain qualified aviators to meet manpower requirements. However, the current program has failed to meet targeted retention across communities while overpaying nearly $5,300,000 during FY-2013, according to Eric Kelso. This thesis examines the potential improvements of applying uniform-price auction, Quality Adjusted Discount (QUAD), and CombiNATOrial Retention Auction Mechanism (CRAM) compensation programs to replace the current bonus system. Incorporating survey results from 2,316 naval officers across Navy Aviation, we analyzed the impact that market-based mechanisms would have on quantity, quality, and cost for retained naval aviators. Using these responses, we developed individual quality scores and reservation prices to apply three auction mechanisms to the retention goals and costs of the FY-2013 ACCP program. Our research shows that a market-based auction could include improvements in cost, quality, and particularly quantity of aviators eligible for the Department Head Screen Board. The uniform-price auction meets all retention objectives across Navy Aviation, while reducing costs in some communities by $1,250,000. The QUAD auction improves the average quality of aviators retained under the uniform-price auction while CRAM demonstrates that non-monetary incentives provide aviators means to remain in service while lowering overall costs to the Navy.

Keywords: Aviation retention, Aviation Career Continuation Pay (ACCP), auction, bonus
MASTER OF SCIENCE
IN
MECHANICAL ENGINEERING

SYSTEMATIC REVIEW OF ULTRASONIC IMPACT TREATMENT
PARAMETERS ON RESIDUAL STRESSES OF WELDED NON-
SENSITIZED VERSUS SENSITIZED ALUMINUM-MAGNESIUM
Eid Fakhouri—Lieutenant, United States Navy
Master of Science in Mechanical Engineering, 2015
Advisor: Sarath Menon, Department of Mechanical and Aerospace Engineering
Co-Advisor: Luke Brewer, Department of Mechanical and Aerospace Engineering

This thesis focuses on the use of X-ray diffraction to measure residual stresses around welds in 5XXX series aluminum-alloys used in naval ship structures both in the laboratory and the field. Tensile residual stresses are commonly generated during welding and, in sensitized alloys, can cause stress corrosion cracking. Peening techniques, such as ultrasonic impact treatment (UIT), can mitigate and possibly reverse these tensile residual stresses. This research uses x-ray diffraction to measure residual stresses around welds in AA5456 after UIT, around welds in AA5083 installed on-board a U.S. naval combatant and in AA5083 after in situ surface preparation. In the AA5456, we examined the importance of UIT parameters such as peening amplitude and pin size. It was found that all combinations of UIT parameters produced significant compressive stress but that some combinations resulted in extensive subsurface intergranular cracking in the sensitized AA5456. Optimal UIT parameters for mitigating the production of subsurface cracking were determined. In the AA5083, we examined the effect of field-based in situ surface preparation on residual stress measurements. The use of a portable X-ray diffractometry system to experimentally measure the distribution of residual stresses in aluminum-alloy ship structures on U.S. Navy vessels has been successfully demonstrated.

Keywords: UIT, ultrasonic impact treatment, residual stress, aluminum-alloys, XRD, X-ray diffraction, AA5456, AA5083, electropolishing, metallography, sub-surface cracking, SCC, stress corrosion cracking

SOLID HYDROCARBON ASSISTED REDUCTION: A NEW PROCESS
OF GENERATING MICRON SCALE METAL PARTICLES
Ryan McCabe—Lieutenant, United States Navy
Master of Science in Mechanical Engineering, 2015
Advisor: Jonathan Phillips, Department of Physics
Co-Advisor: Claudia Luhrs, Department of Mechanical and Aerospace Engineering

The goal of this research is to test a central hypothesis that gas species generated by the thermal and/or catalytically assisted decomposition of hydrocarbons in an inert atmosphere can reduce metal oxides to a metallic state. It is postulated that the decomposition releases gas phase radicals that can bind with oxygen in the metal oxides, forming volatile, stable oxides such as CO2 and water. This research consisted of thermally decomposing several types of solid hydrocarbon, including wax and low-grade coal, both with and without catalysts, in a nitrogen environment at >600 ºC, located immediately below beds of micron scale particles of either NiO or Fe3O4. X-ray diffraction and scanning electron microscopy analysis showed, in support of the hypothesis, both metal oxides reduced to some extent. Nickel oxide reduced fully in many cases, but iron oxide never fully reduced and the extent of reduction was found to be a function of hydrocarbon, catalyst and temperature. These results suggest solid hydrocarbon assisted reduction (SHAR) with further testing and development may
be a practical means to make sub-micron particles suitable in terms of price and quality for use in particle injection molding and 3D manufacturing of precision metal parts.

Keywords: SHAR, reduction, nanoparticles, additive manufacturing, 3D printing

COMPOSITE CASE DEVELOPMENT FOR WEAPONS APPLICATIONS AND TESTING

Cassandra Mitchell–Lieutenant, United States Navy
Master of Science in Mechanical Engineering, 2015
Advisor: Young Kwon, Department of Mechanical and Aerospace Engineering
Co-Advisor: John Molitoris, Lawrence Livermore National Laboratory

Analysis of the dynamic response of cylindrical carbon fiber/epoxy cases containing high explosive fill was conducted using ALE3D finite element software. To develop an accurate model, material compression testing was performed with a Split Hopkinson Pressure Bar apparatus and Instron SATEC machine to verify high-strain rate and low-strain rate behavior, respectively. Resulting failure modes of compression test samples were similar to those found in current literature. Izod pendulum impact testing was performed to provide an intermediate strain rate comparison. An ANSYS model was developed to ensure fracture energy values obtained from Izod impact testing resulted in material stresses within the bounds of the high strain rate and low strain rate testing. The resulting material properties were input parameters for the ALE3D carbon fiber composite model developed by Kwon. The carbon fiber model and this thesis research provide critical information for testing and development in support of Lawrence Livermore National Laboratory’s Agent Defeat Penetrator Project.

Keywords: carbon fiber epoxy, carbon fiber composite, ALE3D, Split Hopkinson Pressure Bar, compression testing, Izod impact testing, Agent Defeat Penetrator

EXTENDING QUAD-ROTOR UAV AUTONOMY WITH ONBOARD IMAGE PROCESSING

Bradley Turnbaugh–Lieutenant, United States Navy
Master of Science in Mechanical Engineering, 2015
Advisor: Oleg Yakimenko, Department of Systems Engineering
Co-Advisor: Feng Lin, National University of Singapore

One of the most dynamic technological advances of the last decade is the development of unmanned and autonomous vehicles. For the military, these vehicles represent a safer and more efficient way of fighting wars in aerial, ground, maritime, and underwater domains. Public and private companies have also vigorously researched these vehicles and used them for a wide range of tasks, from search-and-rescue operations to building inspections. Navigating these vehicles typically involves the use of GPS or other external cues to follow a path, detecting for and correcting errors along the way. The purpose of this research is to investigate the feasibility of tracking a ground target using a quadrotor that navigates solely based on relative position to the target. To achieve this goal, the quadrotor, a Quanser Qball-X4, is fitted with a small camera. By processing the camera’s image and utilizing pitch, roll, and altitude data from other onboard sensors, a targeting solution can be derived. To track the target, the tracking vehicle defines error as any deviation from the desired angular offset from that target, continuously correcting that error to maintain its desired offset. By using relative position, the tracking vehicle can continue to follow the target using its onboard camera.

Keywords: tracking, relative, unmanned vehicles, autonomous vehicles, error, control, offset.
Joint robot-human operations potentially increase the efficiency, effectiveness and safety of the tasks they perform. The utilization of an autonomous underwater vehicle (AUV) as a robotic diver's assistant demands joint, dynamic operations involving precise physical interactions between an AUV, human divers, and the environment, which, in turn, requires a robust, accurate control system. A robot acting as a dive assistant would perform tasks such as tool carrying, worksite illumination, or other general assistance jobs that a dive buddy might perform. Such precise control of the AUV normally requires accurate knowledge of the vehicle's dynamics; however, this high level of accuracy is difficult to obtain without the employment of extensive system identification efforts. Additionally, the utility of the resulting model is greatly diminished if environmental conditions or vehicle configuration change frequently or unexpectedly. An ideal control system allows the AUV to switch between operational modes and objectives while accounting for uncertain environmental conditions, payload configurations, and possible failures of onboard actuators. Adaptive control has many applications in the underwater domain and can give a robotic diver's assistant the flexibility required to enable joint robot-diver operations. Therefore, two adaptive control system approaches, Model Reference Adaptive Control and L1 Adaptive Control, are investigated here for heave control of the Tethered, Hovering Autonomous Underwater System.

Keywords: unmanned underwater vehicle, autonomous underwater system, tethered, hovering, robust control, model referenced adaptive control, L1 adaptive control, parametric uncertainty, time-varying parameters
Using the Climate Forecast System Reanalysis (CFSR) dataset, the synoptic environment of six historical coastally trapped wind reversals (CTWR) along the California coast is examined. Building on the Mass and Bond climatology of 1996, the study uses potential vorticity (PV) as a proxy for the coastal jet and seeks to characterize the forcing of the CTWRs by analyzing their 950-mb potential vorticity plumes. The study also pursues the ability to separate geostrophically-balanced wind reversals synonymous with synoptic systems from unbalanced wind reversals (CTWRs) by taking advantage of the invertibility of PV and using the inversion technique outlined in the August 1991 issue of Monthly Weather Review by Christopher Davis and Kerry Emanuel. The study then applied the methodology to data from July/August 2012/2013 in order to uncover possible CTWRs. The primary findings of this study are as follows: 1) the potential vorticity maximum generated through the offshore flow of the coastal jet is required to move off shore and establish an across-coast PV gradient in order for a CTWR to form/propagate northward of Point Conception and 2) the Davis Emanuel PV inversion technique yielded mixed results, heavily influenced by diurnal effects and subjected to instability due to topographical interactions.

Keywords: coastally trapped wind reversal, potential vorticity, PV inversion, coastal meteorology
The use of vital sign data is a fundamental diagnostic process that is ubiquitous in the delivery of healthcare in military medicine. This process, while providing invaluable information for planning patient treatment, has historically come with administrative challenges in transcription and remote monitoring. New advancements in sensors technologies operating in tactical networks provide a unique opportunity to meet these challenges. This thesis expands upon previous Naval Postgraduate School CENETIX laboratory research into battlefield medicine by providing a qualitative analysis of COTS sensor capabilities within the U.S. Coast Guard network infrastructure. Due to the unique nature of the U.S. Coast Guard and the Department of Defense, utilization of tactical networked radios within a mesh network for transmission of vital sign data is explored.

Keywords: Vital signs, tactical mesh networks, sensors, battlefield medicine

THE ROLE OF EFFICIENT XML INTERCHANGE (EXI) IN NAVY WIDE-AREA NETWORK (WAN) OPTIMIZATION

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Master of Science in Network Operations and Technology, 2015
Advisor: Don Brutzman, Department of Information Sciences
Co-Advisor: Scot Miller, Department of Information Sciences
Second Reader: Don McGregor, Department of Computer Science

Navy afloat units become disadvantaged users, once disconnected from the pier, due in part to the high latency associated with SATCOM. Unfortunately, recent gains in SATCOM capacity alone do not overcome throughput limitations that result from latency’s effect on connection-oriented protocols. To mitigate the effect of latency and other performance inhibiting factors, the Navy is improving its current WAN optimization capabilities by implementing Riverbed Steelhead WOCs. At-sea testing has shown Steelhead increases effective SATCOM capacity by 50%. Laboratory testing demonstrates that by encoding structured and semi-structured data as EXI rather than XML, compression ratios can be further improved, up to 19 times greater than Steelhead’s compression capability alone. Combining EXI with Steelhead will further improve the efficient use of existing SATCOM capacity and enable greater operational capabilities, when operating in a communications constrained environment. Not only does EXI improve compactness of traffic traveling over relatively high capacity SATCOM channels, it also expands net-centric capabilities to devices operating at the edge of the network that are restricted to lower capacity transmission methods. In order to achieve these substantial im-
provements the Navy must incorporate the already mandated DISR standard, EXI, as the single standard for all systems transferring structured and semi-structured data.

Keywords: EXI, efficient xml interchange, EFX, efficient xml, Riverbed, Steelhead, WAN optimization, compression, long fat network, LFN

SOFTWARE-DEFINED AVIONICS AND MISSION SYSTEMS IN FUTURE VERTICAL LIFT AIRCRAFT

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Second Reader: Albert Barreto, Department of Information Sciences

Integrated Modular Avionics, or IMA, has been a notable trend in aircraft avionics for the past two decades, promising significant size, weight, and power-consumption (SWAP) gains, radically increased sensors fusion, and streamlined support costs. Despite the demonstrated success of IMA systems in commercial airliners such as the Airbus A380 and the Boeing 787, military rotorcraft in the service of the United States Joint services have yet to benefit significantly from this technology. At long last, that may be about to change. The Future Vertical Lift Family of Systems (FVL) initiative was launched in 2008, with the aim of re-inventing the entire U.S. rotary wing fleet. Within the FVL program's projected timeline, many signs point to the emergence of a second-generation IMA technology (IMA2G), which will leverage extensive virtualization and software-defined functionality to deliver further SWAP gains, fault-tolerance, and system capability. Development efforts are indeed already underway to integrate such advanced IMA features into the FVL's Joint Common Architecture. This thesis assesses the maturity of IMA2G critical path technologies, validates the alignment between IMA2G benefits and desired FVL attributes, and describes the operational impact that software-defined avionics and mission systems might have on future rotary wing aircraft.

Keywords: Integrated Modular Avionics (IMA), Second-Generation Integrated Modular Avionics (IMA2G), Future Vertical Lift (FVL), Future Vertical Lift Family of Systems (FVLFOS) Joint Multi-Role Technology Demonstrator (JMR-TD), Joint Common Architecture (JCA)

EVALUATION OF EFFICIENT XML INTERCHANGE (EXI) FOR LARGE DATASETS AND AS AN ALTERNATIVE TO BINARY JSON ENCODINGS

This paper has been recognized as an outstanding thesis by its department.
Bruce Hill–Lieutenant, United States Navy
Master of Science in Network Operations and Technology, 2015
Advisor: Don Brutzman, Department of Information Sciences
Co-Advisor: Don McGregor, MOVES Institute

Current and emerging Navy information concepts, including network-centric warfare and Navy Tactical Cloud, presume high network throughput and interoperability. The Extensible Markup Language (XML) addresses the latter requirement, but its verbosity is problematic for afloat networks. JavaScript Object Notation (JSON) is an alternative to XML common in web applications and some non-relational databases. Compact, binary encodings exist for both formats. Efficient XML Interchange (EXI) is a standardized, binary encoding of XML. Binary JSON (BSON) and Compact Binary Object Representation (CBOR) are JSON-compatible encodings. This work evaluates EXI compaction against both encodings, and extends evaluations of EXI for datasets up to 4 gigabytes. Generally, a configuration of EXI exists that produces a more compact encoding than BSON or CBOR. Tests show EXI compacts structured, non-multimedia data in Microsoft Office files better than the default format. The Navy needs to immediately consider EXI for use in web, sensor, and office document applications to improve throughput over constrained networks. To maximize EXI benefits, future
work needs to evaluate EXI’s parameters, as well as tune XML schema documents, on a case-by-case basis prior to EXI deployment. A suite of test examples and an evaluation framework also need to be developed to support this process.

Keywords: Extensible Markup Language (XML), Efficient XML Interchange (EXI), JavaScript Object Notation (JSON), Compact Binary Object Representation (CBOR), Binary JSON (BSON), data serialization, data interoperability

MUOS: APPLICATION IN NAVAL HELICOPTER OPERATIONS
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Master of Science in Network Operations and Technology, 2015
Advisor: Alan Scott, Department of Mechanical and Aerospace Engineering
Co-Advisor: Alex Bordetsky, Department of Information Sciences

The Mobile User Objective System (MUOS) is the next generation of military satellite communications technology. Using a unique combination of satellite vehicles and radio access facilities, MUOS allows the end user unparalleled access to the global information grid (GIG) with a significant increase in voice and data capacity over legacy UFO systems. Leveraging current WCDMA technology used by commercial cellular companies, the MUOS system will allow uninterrupted communications worldwide. This research aims to identify gaps in existing naval helicopter network capabilities and how to apply MUOS to further increase operational effectiveness. Current and legacy helicopter platforms were analyzed regarding connectivity in a network centric environment. Using simple modeling techniques in order to reduce the throughput of the user terminal to 16 kbps enabled a simulation of load times of various Internet applications. Analyzing the load times of web applications gives an initial indication of the viability of MUOS in the rotary wing environment. Even when reduced to a throughput of 16 kbps, many of the applications would still be usable in benign flight regimes. Text- or chat-based applications will see the biggest benefit from MUOS technology, allowing aircrews to quickly disseminate information anywhere in the world.

Keywords: Mobile User Objective System, MUOS, UHF SATCOM, Ultra High Frequency Satellite Communications, Naval Helicopter Satellite Communications
MASTER OF SCIENCE
IN
OPERATIONS RESEARCH

AIR ASSET TO MISSION ASSIGNMENT FOR DYNAMIC HIGH-THREAT ENVIRONMENTS IN REAL-TIME
This paper has been recognized as an outstanding thesis by its department.
Michael Albrecht–Lieutenant Commander, United States Navy
Master of Science in Operations Research, 2015
Advisor: W. Matthew Carlyle, Department of Operations Research
Co-Advisor: Connor McLemore, Operations Analysis Program Office
Second Reader: Johannes Royset, Department of Operations Research

This thesis develops pre-processing algorithms and a mixed integer programming model that solves the route selection and asset-to-mission assignment problem in the presence of threat air-defense systems. Our model and algorithms reduce the planning timeline and coordination burden by handling the heavy computational aspects of the planning process. It takes as input current aircraft, target, and threat information and produces asset-to-mission pairing recommendations that accomplish the mission while providing routes and coordination to reduce the risk from threats by avoiding surface-to-air threats, when possible, or by adding suppression assets, if available. The resulting recommendations are created significantly faster and more reliably than can be done by existing integrated fires methods.

Keywords: weapon-target pairing, air-strike, optimization, battlespace manager, decision aid, high-threat routing, joint fire support, distributed battle management A-star pathfinding, integer programming

COMPARING THE PERFORMANCE OF RESIDENT TO DISTANCE LEARNING STUDENT NAVY OFFICERS AT NAVAL POSTGRADUATE SCHOOL
Kyle Alcock–Lieutenant Commander, United States Navy
Master of Science in Operations Research, 2015
Advisor: Samuel Buttrey, Department of Operations Research
Second Reader: Marigee Bacolod, Graduate School of Business and Public Policy

Earning a college degree is an aspiration of many, and on-line distance learning (DL) is a feasible way to attain that level of education. The Naval Postgraduate School (NPS) offers masters- and doctorate-level degrees to federal government employees via resident and DL means. Does either method of delivery provide a better, or worse, opportunity for strong student performance? Do available student characteristics lead to better performance in one method or the other? This study analyzed the performance of 2,633 student Navy officers in the NPS Graduate School of Business and Public Policy (GSBPP), the Graduate School of Engineering and Applied Science (GSEAS) and the Graduate School of Operational and Information Science (GSOIS) in the DL and resident formats. The analysis used simple linear models, general linear models, and recursive partitioning to determine which of ten-selected predictors can identify strong or poor student performance. Results of the analysis showed the NPS Academic Profile Code (APC) is a strong indicator of an increased probability of success, while DL students in GSEAS and GSOIS are at greatest risk of poor performance. More research is recommended to determine why those students have difficulty succeeding at NPS.

Keywords: academic profile code, distance learning, student performance, linear models, recursive partitioning
Influenza pandemics pose a serious threat to the global population. According to the United States Department of Health and Human Services in 2014, the Spanish flu of 1918 killed almost 100 million people worldwide and Simonsen, Spreeuwenberg, and Lustig in 2013 estimated that the Swine flu more recently killed approximately 180,000 people. Government agencies, from the United States Centers for Disease Control and Prevention down to state and local regions, are prepared to respond to potential influenza pandemics with antiviral, vaccine, and social interventions. Mathematical models can guide policies to save lives. In this thesis, we create an optimization model, implemented in the online tool Texas Antiviral Release Scheduling (TAVRS) that provides the optimal geo-temporal antiviral release schedule to advise decision makers at the Texas Department of State Health Services. We input the antiviral release schedule into an independent disease-spread simulation model to measure the effectiveness of the optimal release schedule. While the TAVRS optimal antiviral release schedule performs comparably to a simple population-proportionate release schedule during a simulated mild 2009-like influenza pandemic, the TAVRS release schedules save an additional 10,000 lives—three to four times greater—than the population-proportionate release schedule when responding to a severe 1918-like influenza pandemic.

Keywords: optimization, epidemiology, antivirals, influenza, Texas, pandemic

This thesis presents Navy Operational Planner (NOP), a decision support aid for mission-based maritime operational planning. Operational plans consist of individual missions grouped into phases—we must accomplish a given fraction of each mission in a phase to declare completion and move to the next phase. Rather than trying to achieve as many missions as possible in a fixed time horizon, NOP advises how to allocate multiple ships to multiple missions in order to accomplish those missions to a prescribed level of completion as quickly as possible; this allows a transition to the next phase of a larger mission, such as a war, or a large-scale humanitarian aid and disaster relief operation. Knowing how long it could take to complete a mission phase is more useful in determining feasibility in the planning process and can help in assessing risks associated with employing a limited number of ships. Criteria for mission phase transitions are derived from assumptions surrounding mission-based accomplishment thresholds. The carrying out of a mission or level of effort applied contributes toward cumulative accomplishment. In addition, when mission efforts are interrupted for some period of time, the mission may require additional later effort to resume and complete.

Keywords: optimization, integer programming, Navy operational planner, maritime operational planning tool, decision aid, Navy logistics, Navy mission planner, NMP, NOP
The Littoral Combat Ship (LCS) is a naval combatant designed to operate in the littoral regions. Twenty-four LCSs will be built over the next five years employing a crew rotation concept where three crews rotate between two ships. During the construction period, an experienced crew must be assigned, which disrupts the desired crew rotation in ships already built. This thesis develops LCS Scheduler (LCSS), a mathematical optimization model using a mixed-integer, linear program (MIP) to aid in assigning LCS crews to LCS ships. LCSS's objective is to minimize the penalty associated with assigning crews outside of their desired ship pairing and/or extending them beyond four months in a phase. Results are compared based on solve time and penalty value. The MIP solution has the best quality. Yet, even for a shorter-than-desired time horizon, it takes many hours of computation. Rolling horizon is a heuristic approach that produces a full, long-term schedule in under an hour but requires manual modifications to misaligned crews. Fix-and-relax is a more-elaborate heuristic with potential benefits to crew alignment for longer-range schedules. The planner must balance solve time and solution quality when determining the approach to LCSS.

Keywords: optimization, integer programming, schedule, littoral combat ship

According to Department of Defense (DOD) Instruction 2205.02 (June 23, 2014), DOD components must conduct humanitarian and civic assistance (HCA) activities in response to regional conflicts or natural disasters. The Under Secretary of Defense for Policy determines how HCA policy is coordinated and implemented within the DOD and delegates responsibility to the regional combatant commands. In past modeling efforts for disaster relief, stochastic optimization has been utilized and produced promising results; however, the deterministic nature of optimization models may not fully capture the uncertainty that is inherent in natural disasters and the demand created by them. In order to better understand the effects of the uncertainty surrounding natural disasters and realize a robust logistical response to these events, new approaches are necessary. This thesis develops an asset allocation optimization model for naval logistics, and then uses experimental design techniques to systematically explore solutions to the model. Our analysis reveals the importance of robust planning for natural disaster response to ensure that demand is met and a quick response is possible. Finally, we explore the use of unmanned aerial vehicles as logistics assets, and show that they have the potential to add much benefit to foreign humanitarian assistance.

Keywords: naval logistics, foreign humanitarian assistance, FHA, design of experiments, DOE, stochastic optimization, unmanned aerial vehicles, UAV
Nuclear powered submarines are most vulnerable to detection and attack while at periscope depth. Submarines also have specific communication and time requirements they have to meet and the primary method of transmitting and receiving data is via satellite, which requires the submarine to be at periscope depth. This means that in a command and control denied environment (C2DE), a submarine may be incapable of receiving orders or transmitting required reports. In order to meet its communications requirements, the submarine has to navigate outside of the denied environment, conduct all necessary satellite communications, and proceed back to the C2DE zone. Through great improvements in unmanned underwater vehicle (UUV) technology and the development of new line-of-sight rapid data transmission methods, submarines may be able to operate in C2DEs and conduct all necessary communications without ever going to periscope depth. This study analyzes different configurations for UUV and submarine interaction in a C2DE area using a series of models in the Map Aware Non-Uniform Automata (MANA) modeling environment. This analysis explores the value of several different UUV characteristics as well as undersea garage configurations in minimizing the time it takes for a submarine to conduct its communications, the latency of the data received, and the cost of construction for the system. The system as modeled shows that the combination of the UUV and blue-green laser can provide the submarine with service times comparable to the time it takes for a submarine to reach periscope depth and expected data latency of less than an hour.

Keywords: design of experiments, simulation, submarines, unmanned underwater vehicles (UUVs)
Operational planners strive to find ways to load missiles on Vertical Launch System (VLS) ships to meet mission requirements in their Area of Responsibility (AOR). Requirements are variable: there are missions requiring specific types of missiles; each ship may have distinct capability or capacity to meet every mission; each ship may have a set number of missiles in inventory; and each mission will have a different priority. As a result, the missile-to-ship assignment is labor intensive. Operational planners manually specify the missile loadout, providing recommendations with no assurance that some other plan might not be much better in practice. This thesis provides operational planners with a programming tool, the VLS Loadout planner (VLP), to advise the optimal loadout for VLS ships deploying to be ready to execute demanding and high-threat missions. This research employs the VLP model to demonstrate the optimal missile loadout and mission coverage of two fictitious war plans, with 52 missions, on a two-deployment cycle, using 21 VLS-capable ships, and employing a variety of seven types of missiles. The thesis concludes that VLP provides operational planners a recommended loadout for every ship deploying to 7th Fleet (Western Pacific) AOR.

Keywords: Vertical Launch System, missiles, ships, threats, missions deployment cycle, optimization, war plans.
This study examined the effect a variety of induced velocity shears had on salt finger formation. Two harmonic, single frequency velocity profiles were utilized under varied shear strength and angular frequency. The third multi-frequency experiment employed a stochastic shear wave field. This model used frequencies that conformed to the GM spectral model for internal waves with an initial random phase distribution, modeling an environment representative of typical oceanic conditions. These shear profiles were incorporated in a double diffusion numerical model. The model resolved the formation and development of salt fingers and recorded the resultant salt and heat fluxes. The results showed that shear strength and direction influenced salt finger diffusion rates and structure alignment. For a stochastic environment, this effect is driven largely by near-inertial motions. The low-frequency waves align salt fingers, and the wax and wane of these waves impact the instantaneous diffusive rates. These internal waves reduced the salt and heat flux to that representative for un-sheared two-dimensional double diffusion simulation.

Keywords: double diffusion, salt fingers, density ratio, Richardson number, direct numerical simulation, dimensional analysis, Garrett-Munk.
NASA designed the Kepler spacecraft to detect extrasolar planets, but after several successful years, with many new discoveries, two out of four reaction wheels failed. NASA repurposed Kepler to continue science under the new mission, K2. The physics of how Kepler detects planets, the transit method, is first described. As part of this description it is shown that pointing noise is the limiting factor of Kepler’s ability to detect planets. The second part of this thesis uses a flat plate solar torque model of Kepler in order to assess the capabilities of the spacecraft in other off ecliptic attitudes. This analysis concluded that the controllability of the failed spacecraft in the presence of the solar torque is the main driver for the new K2 mission attitude and that conducting science out of ecliptic plane attitudes present challenges from the control point of view.

Keywords: Kepler, solar torque, spacecraft, photometric precision, planet detection, K2, flat plate Kepler model, solar radiation pressure, star classification, transit method, planet definition
The military applications for miniature, low-cost satellites that could be quickly launched to provide ad-hoc tactical networks have risen in recent years. Currently, the smallest practical variant of these miniaturized satellites is known as the picosatellite. In order to evaluate the performance of the picosatellite constellation-based network, a model that can accurately simulate the orbital physics of the constellation as well as the satellite-to-ground communication links and data traffic is necessary. The focus of this thesis was to build such a model using commercially available software and assess the effects of orbital geometries on the performance of the picosatellite constellation-based network. The research revealed that orbital planes that were inclined near the latitude of the area of interest could provide better coverage. In addition, when the satellites were spaced farther apart in the orbital plane the constellation access times were also extended. This was at a cost, however, as the link quality could be compromised. The model that was created for this research could be integrated into the Naval Postgraduate School Tactical Network Topology testbed environment to study the extension of tactical networks to orbit and allow the modelling of picosatellite architectures applied to different maritime and inland missions.

Keywords: picosatellite, quality of service, link margin, bit error rate, access time, network, modelling, constellation

The objective of this research is to address the feasibility of designing prograde orbits for commercial electro-optical satellites. This study explores prograde orbits (inclined less than 90°) populated by small, inexpensive but proven commercial satellites, like SkySat-1 of SkyBox Imaging Inc. The benefits of using prograde orbits are increased coverage duration and decreased revisit, or gap, times for point targets at most latitudes. Disadvantages include a reduction of high-latitude target coverage (sometimes completely), a more elaborate ground architecture, and the increased expense of populating a constellation of these satellites—to mitigate the laws of orbital mechanics—in order to achieve the desired benefits of prograde inclinations. This thesis considers orbital plane inclinations of 30°, 45°, and 60°; designs a few 24-satellite prograde constellations; and compares the performance of these newly formed constellations to the traditional sun synchronous orbit. As anticipated by the orbital mechanics, the results show that annual coverage can increase up to 6.5 times, average access in-
creases up to 6.94 per day, and revisit time can be reduced to as low as 2.0 hours. In addition, the approximate annual life-cycle cost will likely fall beneath $0.5 billion.

Keywords: space operations, prograde inclination, constellations, coverage, revisit, daily access, commercial satellites, electro-optical

QUALITY INITIATIVES IN THE COMMERCIAL DEVELOPMENT OF REUSABLE LAUNCH VEHICLES
Derick Perry–Captain, United States Air Force
Master of Science in Space Systems Operations, 2015
Advisor: Stephen Tackett, Space Systems Academic Group
Second Reader: Mark Rhoades, Department of Systems Engineering

This thesis examines positive tools and techniques accessible and helpful to improving quality of the Reusable Launch Vehicle (RLV). Over the last three decades, NASA has directly been involved in developing modern and technologically improved RLVs. The technologies were projected to facilitate cheaper access to orbital space, as evidenced by its past X-programs and space launch initiatives. Different private firms have attempted and are still attempting to develop new RLVs for orbital space applications. The large development expenses of these kinds of systems, coupled with the downturn of the Low Earth Orbit market, have made development of RLVs, in particular by the commercial sector, increasingly difficult. For these reasons, most commercial space transportation firms have shifted their focus toward suborbital market opportunities, where the technical challenges are lower and market entry is less expensive. This thesis identifies techniques within Lean Aerospace Initiative that are employed by market players today and also best suited for the RLV effort. Additionally, this thesis provides a historical perspective of both RLV development efforts within the government and industry, as well as origins of modern quality teachings to establish a universally accepted foundation of knowledge, upon which further examination can be based.

Keywords: Commercial Reusable Launch Vehicle, LAI, RLV, lean, Lean Advancement Initiative, Lean Aerospace Initiative
MASTER OF SCIENCE
IN
SYSTEMS ENGINEERING

The following capstone project reports were produced by cohorts of residential or distance learning students in the systems-engineering curriculum. The degrees awarded include Masters of Science in Systems Engineering, Systems Engineering Management, and Engineering Systems.

STANDARDIZATION OF SOFTWARE APPLICATION DEVELOPMENT AND GOVERNANCE
Peter Labbe—Civilian, Department of the Navy
Master of Science in Systems Engineering Management, 2015
Advisor: Raymond Madachy, Department of Systems Engineering
Co-Advisor: John Michael Green, Department of Systems Engineering

A number of Defense Department initiatives focus on how to engineer better systems that directly influence software architecture, including Open Architecture, Enterprise Architecture, and Joint Information Enterprise. Additionally, the Department of Defense (DOD) mandates moving applications to consolidated datacenters and cloud computing. When examined from an application development perspective, the DOD lacks a common approach for incorporating new technology or developing software-intensive systems that will be included in the proposed consolidated datacenters and cloud computing. This thesis will outline an architectural framework incorporating a common approach for software development based on a standard approach. The result of this research will be a high-level guide that defines a methodology that incorporates architectural frameworks, and aligns with high-level policies and guidance to ensure more commonality and structure for software programs. This thesis shows how a common methodology incorporating commercial technology into defense systems can establish a common framework for application and technology development. This is not a simple problem to solve, but, if not addressed, DOD application development will fall further behind the commercial market. Without clear direction to the acquisition community on how to build applications, there will be a lack of alignment between strategic goals and future technology implementation.

Keywords: software development, SOA, software ecosystem, software architecture, software standards, commercial software development

A SYSTEMS ENGINEERING APPROACH IN PROVIDING AIR DEFENSE SUPPORT TO GROUND COMBAT VEHICLE MANEUVER FORCES
Jianhao Ng—Civilian, Defence Science and Technology Agency, (Singapore)
Master of Science in Systems Engineering, 2015
Advisor: Gary Langford, Department of Systems Engineering
Second Reader: Douglas Nelson, Department of Systems Engineering

Ground combat vehicles are susceptible to aerial threats. During maneuver, the formation may be in unfamiliar territory and without established local air defense support. Mobile air defense may be required to increase the survivability of ground combat vehicles during movement. Depending on the air capability of the adversary and operation area, the required architecture of mobile air defense systems may vary. There is an identified capability gap for mobile air defense in the U.S. Armed Forces in operating environments with terrain. Using a systems engineering approach, this study looks into the stakeholder needs and functions required to
fulfill this capability gap. In defining the physical architecture, there are many factors that could affect the
design of a mobile air defense system. Physically addressing all permutations of the attributes would be oner-
ous and inefficient. For an identified concept of operations, a design of experiment was used to expedite the
assessment process by identifying significant design factors. The objective is to provide program managers
with a mobile air defense system assessment framework. The framework currently utilizes indicative responses
in lieu of inaccessible combat data. When used in conjunction with real data, the framework would help make
the acquisition process more efficient.

Keywords: systems engineering, mobile air defense, ground combat vehicle, design of experiment

MEETING THE CHALLENGE OF INSTALLING CANES
DURING NEW SHIP CONSTRUCTION ON LPD 28
Alan Philpott–Civilian, Program Executive Office C4I
Master of Science in Systems Engineering Management, 2015
Advisor: David Olwell, Department of Systems Engineering
Second Reader: Raymond Madachy, Systems Engineering

The budget to build ships and modernize and sustain the C4I systems installed is limited. Lead times for
contracting are long, while technology changes rapidly after contract award. The shipboard C4I network
examined in this thesis typifies this dichotomy. The challenge is to provide the latest shipboard network that
meets the C4I capability needs of the warfighter at ship delivery, while at the same time supporting the ship-
builder’s need for Government Furnished Information (GFI) and Government Furnished Equipment (GFE)
supporting the Ship Construction schedule. This thesis analyzes whether to install the legacy Shipboard Wide
Area Network (SWAN), where the FGI is firm, or install the newer Consolidated Afloat Network Enterprise
System (CANES), where the GFI is evolving, on LPD 28 during New Ship Construction. Recommendations
include implementation of the Design Budget Approach during New Ship Construction, use of the Systems
Engineering (SE) V Method during C4I network system development to verify and validate warfighter re-
quirements can be net, and a commitment to the GFE Program of Record (POR) C4I network solutions.

Keywords: Program Management, Acquisition Strategy, Engineering and Manufacturing Development, Naval
Information Technology, C4I, technology refresh, New Ship Construction, SCN, Design Budget, Shipbuild-
ing

RESEARCH AND ANALYSIS OF POSSIBLE SOLUTIONS FOR
NAVY-SIMULATED TRAINING TECHNOLOGY
Systems Engineering Cohort 311-133A_Laser-Based Training Assessment Team
Master of Science in Systems Engineering or Master of Science in Engineering Systems, 2015
Advisor: Ronald Carlson, Department of Systems Engineering
Co-Advisor: Joseph Sweeney, Department of Systems Engineering

Training of military forces is essential to prepare our military to be successful in combat. Research and analy-
sis has revealed that the Navy currently has a gap in its ability to train against Fast Attack Craft (FAC)/Fast
Inshore Attack Craft (FIAC) attacks. The objective of this capstone project was to research current training
capabilities, determine training requirements, determine what training gaps remain based on analysis of a
prototype laser-based training system, and provide recommendations to meet the needs for a Navy live-
simulated training environment. Currently, there is no single technology that can satisfy all training needs and
requirements of the Navy to defend against this threat. Recommendations include further evaluation of the
prototype system, using the prototype during certain training exercises, and blending several technologies into
one combined training system. Laser-based technology can benefit the Navy when used in the right training scenarios and with the correct blend of technology.

Keywords: MILES, I-TESS II, training, fast attack craft, fast inshore attack craft, laser, FAC, FIAC

COMPREHENSIVE SYSTEM-BASED ARCHITECTURE FOR AN INTEGRATED HIGH ENERGY LASER TEST BED
Systems Engineering Cohort 311-133O_HEL Test Bed Team
Master of Science in Systems Engineering or Master of Science in Engineering Systems, 2015
Advisor: John Green, Department of Systems Engineering
Co-Advisor: Bonnie Young, Department of Systems Engineering
Co-Advisor: Douglas Nelson, Department of Systems Engineering

This study focuses on developing a conceptual architecture and a set of requirements for testing and evaluating High Energy Laser (HEL) weapon systems and atmospheric characterization tools in a maritime environment. A systems approach was taken, which started with the development of specific requirements. These stakeholder-derived requirements were then translated into capabilities that the test bed must have. A Model-Based System Engineering approach was used to develop physical, functional, and allocated models of the HEL test bed and all its components. An Analysis of Alternatives (AoA) was then performed among multiple test bed variants to determine how well each variant accomplished the desires of the stakeholders from a cost, schedule, and performance perspective. Finally, a systems integration plan was developed to successfully combine subsystems and components involved to ensure that their synthesis adequately met the system's high-level requirement and function. The essential elements for developing a fully capable HEL test bed have been identified in this study. Based on the derived criteria and AoA that was performed, it appears that the best solution for the Navy at this point would be to centralize all HEL testing in one single location.

Keywords: High Energy Laser, HEL, test bed, maritime, architecture, Systems Engineering, Directed Energy, DE, instrumentation

DISTANCE SUPPORT IN-SERVICE ENGINEERING FOR THE HIGH ENERGY LASER
Systems Engineering Cohort 311-133O_Team Raising HEL from Distance
Master of Science in Systems Engineering or Master of Science in Engineering Systems, 2015
Advisor: John Green, Department of Systems Engineering
Co-Advisor: Douglas Nelson, Department of Systems Engineering
Co-Advisor: Bonnie Young, Department of Systems Engineering

The U.S. Navy anticipates moving to a shipboard high-energy laser program of record in the fiscal year 2018 and achieving an initial operational capability by 2020. The design of a distance support capability within the high-energy laser system was expected to assist the Navy in reaching this goal. This capstone project explored the current Navy architecture for distance support and applied system engineering methodologies to develop a conceptual distance support framework with application to the high-energy laser system. A model and simulation of distance support functions were developed and used to analyze the feasibility in terms of performance, cost, and risk. Results of this capstone study showed that the implementation of distance support for the high-energy laser system is feasible and would reduce the total ownership cost over the life of the program. Furthermore, the capstone shows that moving toward the team’s recommended distance support framework will address current gaps in the Navy distance support architecture and will provide a methodology tailored to modern enterprise naval systems.

Keywords: distance support, high energy laser, systems engineering, distance support framework, CONOPS, IDEF0, modeling and simulation, cost analysis, risk analysis
A kill assessment system built into a High Energy Laser (HEL) Combat System will provide the U.S. Navy with a method to efficiently engage threats with an HEL effector, improve the weapon scheduling function, and help manage ship’s limited power resources. Near real-time battle damage assessment (BDA) and Dwell Time determinations make up the new kill assessment system, which is simply called the BDA System. This system is a critical force-multiplier for ship survivability by limiting all HEL-target engagements to the minimum dwell time required for threat mitigation, while providing a mission kill interface to the Combat System for a calculated decision point to either re-engage the same threat or engage the next assigned target. This new BDA system concept for a shipboard HEL Combat System was analyzed in order to verify an expected increase in overall system efficiency and performance. The minimum desired increase of threat engagement efficiency was set at 25%. The proof of concept model developed for this project shows that adding a BDA system function to the HEL Combat System causes the system to exceed this threshold of efficiency.

Keywords: high energy laser, battle damage assessment, layered defense, asymmetric threats, directed energy warfare, swarm, surface ship combat system assessment, anti-access area denial
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